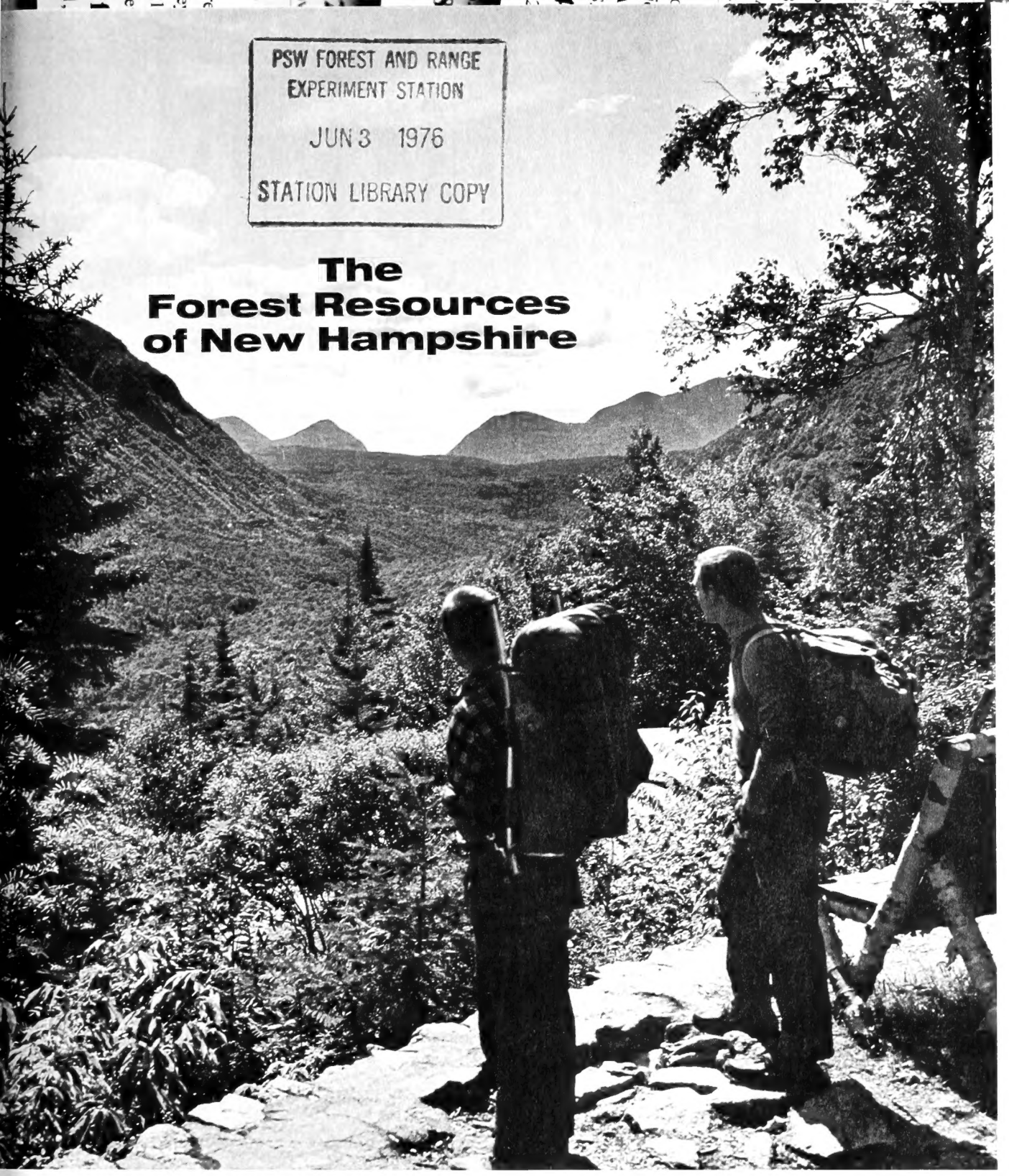
The Forest Resources of New Hampshire



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FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
6816 MARKET STREET, UPPER DARBY, PA. 19082

FOREWORD

UNDER THE AUTHORITY of the McSweeney-McNary Forest Research Act of 22 May 1928 and subsequent amendments, the Forest Service, U.S. Department of Agriculture, conducts periodic forest surveys of all states to provide up-to-date information about the forest resources of the Nation.

The first forest survey of New Hampshire was made in 1947 and 1948 by the Northeastern Forest Experiment Station, with the cooperation of many individuals, forest industries, and state agencies. A second forest survey was completed in 1959.

This third survey was made in 1971 and 1972, again with the cooperation of many individuals and agencies. Special thanks are due to Theodore Natti, Director, New Hampshire Department of Resources and Economic Development, Bureau of Resource Development, and Roger M. Leighton, Cooperative Forest Management Supervisor, Cooperative Extension Service, University of New Hampshire, and their staffs, for their continuous assistance and support.

The third inventory of New Hampshire was directed by Carl E. Mayer, Forest Survey Project Leader. He was assisted by Joseph E. Barnard, who was responsible for the design of the inventory and sample selection as well as for supervision of data compilation. John R. Peters supervised the photo interpretation and the data collection by field crews. David R. Dickson applied the generalized data-processing systems, FINSYS, to the specific data needs of the New Hampshire inventory and produced summary tables for the State and by counties and units. Teresa M. Bowers assisted in the inventory design by performing all the calculations necessary for sample-size determination and plot selection. She was responsible for the coordination of key-punching and other data-preparation tasks and the final preparation and statistical checking of tables for the report. James T. Bones, with the assistance of state personnel, collected and compiled the data on timber-products output and industrial utilization of timber. He was assisted in the compilation phase by David R. Dickson and Teresa M. Bowers. Carmela M. Hyland was responsible for administrative and secretarial services.

Roland H. Ferguson and Joseph E. Barnard checked the consistency of the new inventory with previous inventories. They made frequent use of the TRAS model in this phase of the data analysis and in the 30-year projections of timber volumes.

The photo-interpretation phase of this inventory was completed in March 1972, and the last field plot was measured in December 1972. Final computer output was available in September 1973. Users of this report who have a need for more detailed information or analysis than is presented here should call on the Forest Survey project, Northeastern Forest Experiment Station, Upper Darby, Pa., 19082. *Users of this report are strongly advised to read carefully the definitions of forest-survey terms and the section on the reliability of the estimates in the appendix of this report.*

DICK SMITH PHOTO

COVER PHOTO: A hiker's view of Zeeland Notch. The forests, mountains, and waters of New Hampshire are the basis for a thriving recreation and tourist industry.

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by Neal P. Kingsley

The Forest Resources of New Hampshire

The Author

NEAL P. KINGSLEY, research forester, received his bachelor's degree in forestry from the University of New Hampshire in 1961 and his masters degree in forest economics from the same university in 1963. He joined the Northeastern Forest Experiment Station in August 1962 and is now resource analyst in the Experiment Station's Forest Survey unit at Upper Darby, Pa.

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DICK SMITH PHOTO

A wintry view of Moat Mountain from Wildcat Mountain.

Highlights

- New Hampshire has about the same acreage of commercial forest land that it had in 1948—nearly 4.7 million acres. This is about 400,000 acres more than the State had in 1776.

- 87 percent of the commercial forest land is privately owned.

- There are an estimated 87,500 owners of privately held forest land. They own an average of 46.7 acres each.

- The area of the maple/beech/birch type declined more than 860,000 acres, while the area of elm/ash/red maple increased by nearly 650,000 acres since 1948.

- Though the area of commercial forest land did not change, the volume of growing stock increased 60 percent, and the volume of sawtimber rose 39 percent during the past 25 years.

- White pine is the most abundant species in the State. Red maple replaced yellow birch as the most abundant hardwood species. Northern red oak is the most abundant hardwood sawtimber species.

- Although white pine is the most abundant species, sawtimber quality is poor: 89 percent is in grade-3 or poorer sawlogs.

- One tree in three in New Hampshire is too rough or rotten to be considered growing stock.

- Timber removals are well below the potential of the State's forests to produce.

- Present timber removals are at about half the 1948 level.

The Third Survey

EVER SINCE THE FIRST settlements were founded at Dover and Portsmouth in 1623, forests have been an important part of the New Hampshire economy. Indeed by 1680 the export of forest products from Portsmouth was such a thriving industry that the Provincial Council of New Hampshire petitioned the Lords of Trade in England to make Portsmouth a free port so that New Hampshire could maintain its competitive position in this trade *(Belknap 1831)*.

In the money-scarce colonial economy, timber became a medium of exchange. In 1680 taxes were frequently paid in lumber at the following rates *(Belknap 1831)*:

Merchantable white pine boards/m	30S
White oak pipe staves/m	£ 3
Red oak pipe staves/m	30S
Red oak hardwood/m	25S

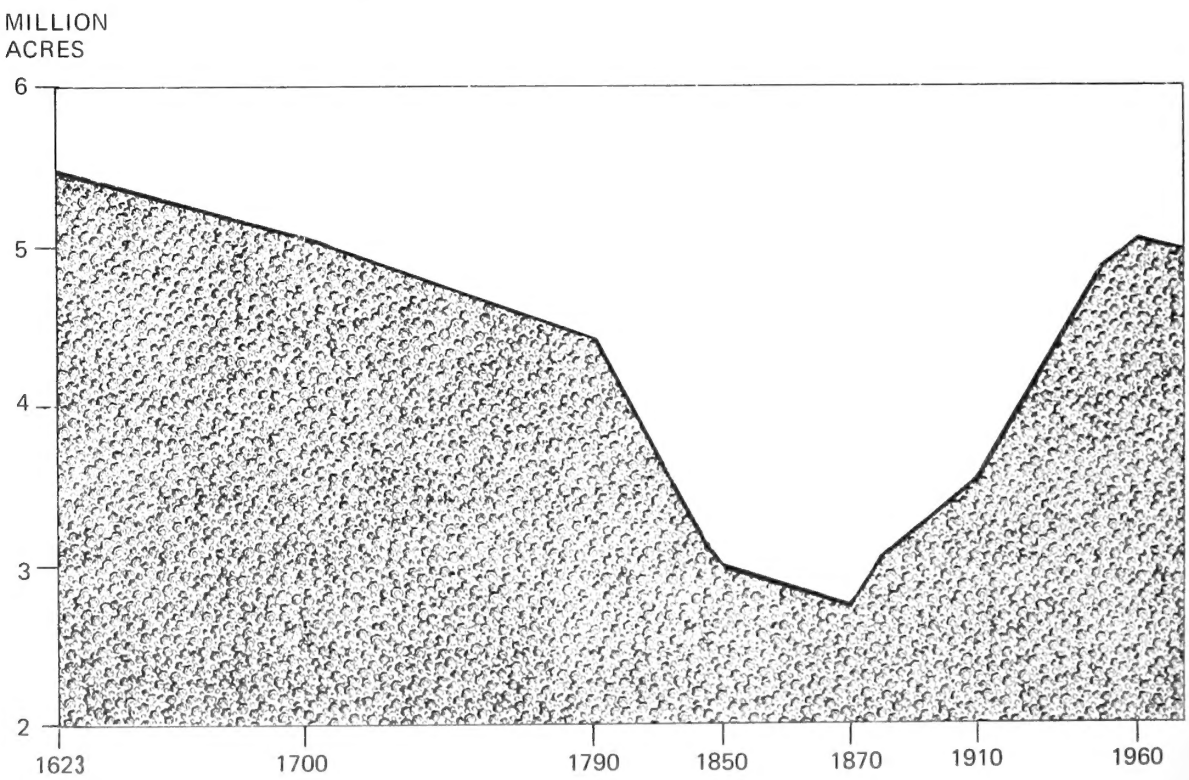
A rough conversion to dollars at the then-prevailing price of silver shows the sum of these items to be worth about $17.

As settlers moved into the interior, they cleared land for homes and farms. From first settlement till about 1870, the area of forest land in New Hampshire declined steadily to a low of 2.8 million acres or 48 percent of the State's land area.

The development of railroads caught up with farming in New Hampshire about 1870. The more productive areas of the West and Midwest then had a competitive advantage over New Hampshire in the Boston and New York markets. More and more of the less profitable farms in New Hampshire were abandoned, and forest once more reclaimed the land. This trend continued without interruption until 1960.

Today one may find old stone walls, cellar holes, and other remnants of these farms even in isolated forest locations miles from habitation. It is difficult to realize that forests today cover more of New Hampshire's land than they did at the time of the American Revolution (fig. 1). New Hampshire today is the

Figure 1.—The trend of forest land cover in New Hampshire since 1623.



second most heavily forested state in the Nation—second only to Maine.

Two industries that depend heavily on the forest thrive side by side in New Hampshire—timber production and outdoor recreation. Although timber production has declined substantially in recent decades, the growth of the recreation and tourist industry has been phenomenal. The challenge for the future is for the forests to continue to provide an increasing supply of timber products while at the same time enhancing those forest values upon which recreation and tourism depend.

This report includes a discussion and analysis of the results of the third forest survey of New Hampshire, which was completed in 1973. The first forest survey was completed in 1948 and the second in 1960 *(Larson et al. 1954; Ferguson and Jensen 1963)*. Through the years many definitions, procedures, and methods have been changed as a result of improved forest-inventory and data-processing techniques. This means that to analyze actual trends between forest surveys, the initial survey estimates must be put on a basis comparable to the resurvey estimates. The 1948 and 1960 estimates are valid for the procedures and definitions used at those times. The trends in commercial forest-land area and growing-stock volume, after adjustment of the 1948 data to present standards, are shown below:

Change in Area and Volume, 1948-73

	1948	*1973*	*Change*
Commercial forest land (thousand acres):	4,682	4,692	+10
Growing-stock volume (million cubic feet):			
Softwoods	2,085.5	3,139.9	+1,054.4
Hardwoods	2,023.1	3,438.7	+1,415.6
Total	4,108.6	6,578.6	+2,470.0
Sawtimber volume (million board feet):			
Softwoods	5,667.0	7,625.0	+1,958.0
Hardwoods	3,762.0	5,440.6	+1,678.6
Total	9,429.0	13,065.6	+3,636.6

Forest Area

Forests now cover 86 percent of New Hampshire's land area—a total of 4,985,100 acres. Of this, 4,692,000 acres or 81 percent of the land area is classed as commercial forest land. This is land that is producing or is capable of producing crops of wood and is not withdrawn from timber utilization by statute or administrative order.

Total forest area has declined only 1 percent since the previous forest survey in 1960. However, the area of commercial forest land in the State has declined 4 percent. Increases in both the area of productive reserved forest land and in unproductive forest land accounted for these changes. The area of productive reserved forest land rose from 23,500 acres in 1960 to 48,700 acres in 1973, due primarily to a change in classification of some of the forest land owned by town and city governments (from commercial forest land to productive reserved). The large increase in unproductive forest land was due mostly to the reclassification of 70,000 acres in the White Mountain National Forest. Forest land is sometimes reclassified in this manner when it has been shown that these areas are not capable of producing a previously specified volume of wood per year.

Commercial forest land is quite evenly distributed throughout the State. None of the 10 counties is less than 71 percent forested. The areas of commercial forest land range by counties from Rockingham, the most densely populated county, with 71 percent; to Coos and Carroll Counties, each with 86 percent.

Though the net change in commercial forest was only 0.2 percent since 1948, the changes were not evenly distributed throughout the State. For purposes of comparison, the State was divided into two geographical units. The Northern Unit consists of Carroll, Coos, and Grafton Counties; the Southern Unit consists of Belknap, Cheshire, Hillsborough, Merrimack, Rockingham, Strafford, and Sullivan Counties.

The Northern Geographic Unit increased 1.5 percent in commercial forest area while the Southern Unit declined 1.1 percent. Rockingham County showed the greatest decrease—down 3.5 percent, due primarily to increasing

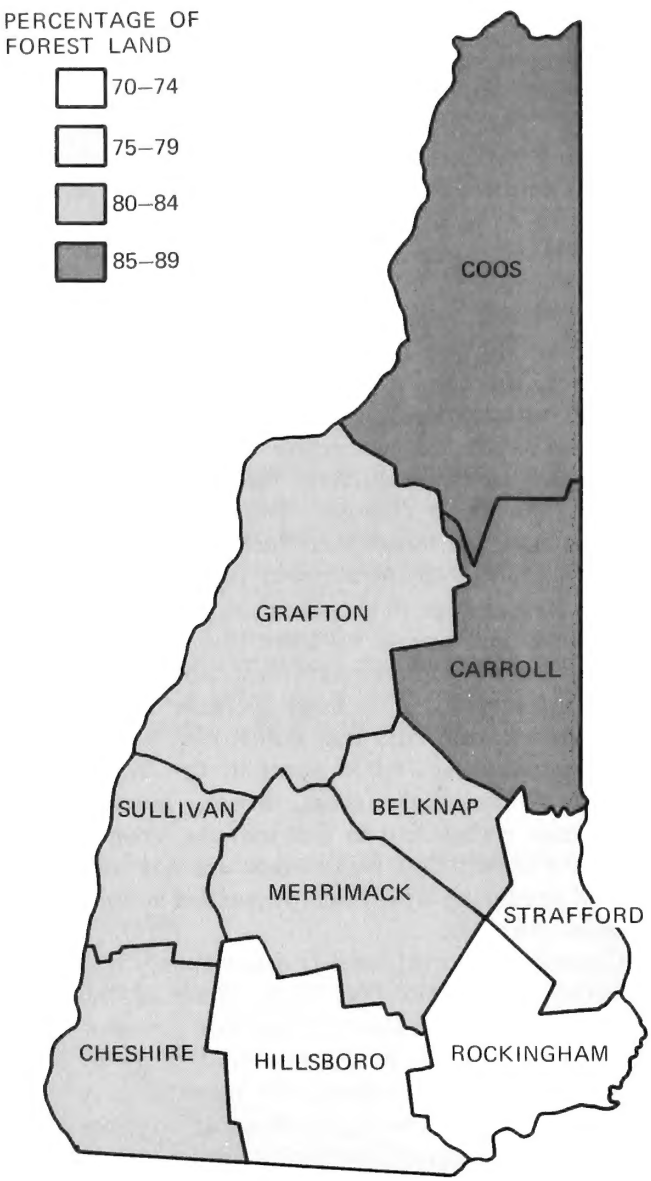


Figure 2.—Percentage of land area in commercial forest in New Hampshire, by counties, 1973.

urbanization. Grafton County showed the largest gain—up 2.8 percent, due mostly to continued farm abandonment. Figure 2 shows New Hampshire's counties by percentage of commercial forest land.

Of the 14 percent of New Hampshire that is not forested land, only 3 percent is in crop and pasture land. By contrast, around 1870 more than half the State's land area had been cleared, mostly for agriculture.

Forest-Land Ownership

Commercial forest land in New Hampshire is overwhelmingly in private ownerships. Only 13 percent is in public ownership. Most of the public ownership, 489,200 acres, is the White Mountain National Forest. Other federally-owned Commercial forest land totals 12,600 acres. State-owned commercial forest land totals 79,200 acres, while counties and municipalities own another 28,900 acres.

The 4.1 million acres that are in private ownerships are held by an estimated 87,500 owners. Of these owners, 86,100 are individuals; 1,000 are corporations of various kinds; and 400 are clubs, youth organizations, churches, and similar associations. The average size of ownership in New Hampshire is 46.7 acres. But ownerships range in size from as little as 1 acre to as much as 199,000 acres. Most owners—55,900 of them—hold fewer than 10 acres of forest land. In fact, the 31,600 who own more than 10 acres hold 96 percent of the privately owned commercial forest land in the State.

These estimates of privately owned commercial forest land are based on a canvass of forest-land owners that was conducted concurrently with the resurvey. The results of this study will be published separately.

Of the 86,100 individuals who own commercial forest land in New Hampshire, only 1,100 —1 percent—are farmers; and they own only 175,600 acres. The largest group of owners are white-collar workers, followed by skilled laborers, professional people, and retired persons.

Of the 1,000 corporations that own commercial forest land in New Hampshire, the largest group—600—are involved in real estate or other types of land development. This group of owners hold 127,300 acres of commercial forest land. Forest industries number fewer than 50, yet they hold the lion's share of the commercial forest land held by corporations—946,900 acres.

One of the main objectives of conducting the canvass of forest-land owners in New Hampshire is to enable us to estimate the volume of timber on privately owned commercial forest land that is now or may in the future be available for timber harvesting. Eighteen percent of the present forest-land owners in New Hampshire have at one time or another harvested

timber from their land. These owners, though not large in number, own 65 percent of the private commercial forest land in the State. It is also interesting to note that only 4 percent of the owners said that they own forest land primarily for timber production, yet they own 23 percent of the private forest land.

Forest Types

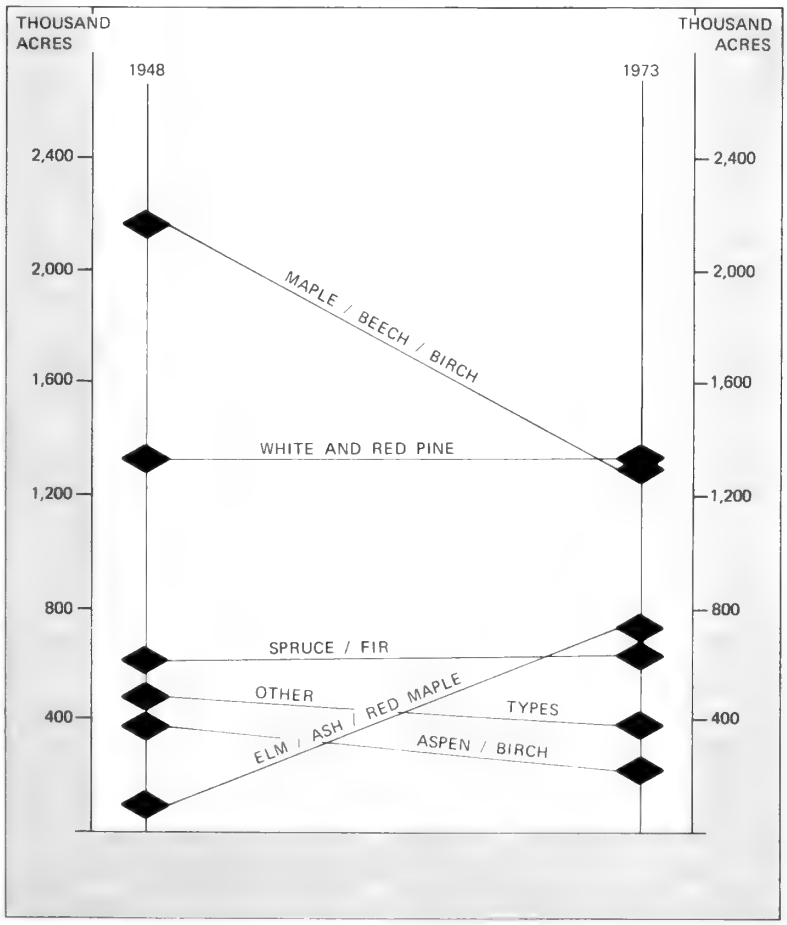
Forest type classifications and definitions used in this forest survey are essentially the same as those used in the 1960 forest survey. They differ, however, from those used in the initial forest survey of 1948. Because of these differences, caution must be exercised in the analysis of trends in forest types. Figure 3 shows the changes in area of the major forest types.

Twenty-four local forest types were recognized in this resurvey of New Hampshire. These local types were grouped into eight major types. For example, the major forest type—white pine and red pine—is made up of four local forest types found in New Hampshire: red pine (14,300 acres, mostly plantations), white pine (809,500 acres), white pine/hemlock (339,400 acres), and hemlock (181,400 acres).

White pine/red pine. The area of the white pine/red pine type changed very little between 1948 and 1973. In 1973 this type occupied 1,344,600 acres of commercial forest land. In 1948 it occupied 1,314,900 acres.

The reason why white pine was able to hold its own is that the demand for white pine boxlumber declined dramatically after World

Figure 3.—Changes in forest area in New Hampshire, by types, 1948-73.



A typical old-growth maple/beech/birch stand in New Hampshire.

War II. However, the demand for white pine lumber, particularly in the better grades, has always remained strong.

Spruce/fir.—The spruce/fir type occupies 635,900 acres of New Hampshire's commercial forest land, up slightly from the 1948 area of 607,000 acres. Most of this, 405,600 acres, is in the balsam fir local type. The red spruce/balsam fir local type accounts for 216,100 acres, and the northern white-cedar and white spruce types together account for the remaining 14,200 acres.

The spruce/fir type has been the mainstay of the woodpulp industry in the Northeast. It has been common practice in pulpwood harvesting to cut to a minimum diameter. This favors the restocking of cutover areas with balsam fir. However, recent trends in the woodpulp industry are away from the preponderant use of spruce and fir in favor of the utilization of hardwoods. Also, the industry has tended toward more clearcutting. These two trends may foster the development of more spruce/fir and spruce-fir/hardwood stands rather than pure balsam fir.

Maple/beech/birch. — The maple/beech/birch type (northern hardwoods) is the most extensive hardwood type in New Hampshire. With 1,308,300 acres, it ranks just behind the white pine/red pine type as the most extensive of all forest types in the State. The area of northern hardwoods in New Hampshire has declined. In 1948 this type covered 2,170,000 acres, but by 1973 it had dropped to 1,308,300 acres.

Although a substantial portion of this decline is undoubtedly real, some of it can be traced to changes in the method of determining forest types. In the initial forest survey, forest types were classified ". . . according to the species, or species group, that makes up the major part of the stand in terms of board-feet in sawtimber stands or number of stems in other stands". It is common for maple/beech/birch sawtimber stands to contain a large number of red maple poletimber and smaller trees in an understory. Under the earlier system of forest typing, these trees would not have been considered in sawtimber-size stands. Undoubtedly, if these stands had been typed according to the 1973 procedure, which is based on the basal-area stocking of all live trees, many would have been classified as elm/ash/red maple stands.

This change in the method of classification, however, cannot account for all of the decrease in the area of maple/beech/birch. Red maple is not one of the more marketable species. For this reason many stands were harvested in which only the most salable trees, mainly sugar maples and birches, were harvested. This practice had the effect of converting many maple/beech/birch stands to red maple. A higher demand for red maple for pulpwood may help to curb this practice in the future.

Elm/ash/red maple.—This type now covers 737,600 acres of commercial forest land in New Hampshire—up from 90,000 acres in 1948 and 203,600 acres in 1960. As mentioned previously in the discussion of the maple/beech/birch type, part of this increase is due

to changes in the methods of determining forest type, while the rest is the result of past harvesting practices. However, an additional factor in considering the increased area of elm/ash/red maple is the pioneer character of the type. As farms and pasture revert to forest land, this type is often one of the first to become established on the area. This is particularly true of the more moist bottomland sites.

Oak types.—In New Hampshire the oak/hickory type group accounts for 322,900 acres. The northern red oak local type makes up 251,100 acres of the total. The remainder is made up of a mixture of other oak types, including the black oaks and the white oaks. It should be noted that although this major type is named oak/hickory, hickory is found only in southern New Hampshire and is not common in the oak/hickory type found elsewhere in the State. Throughout the central and southern portions of this type's range, which includes most of the Appalachian highlands, hickory species are common.

Another oak type is oak/pine. This type covers 72,700 acres, mostly in the white pine/red oak/white ash local type.

Aspen/birch.—This type, although declining in area, is still an important type in New Hampshire. In 1948 the aspen/birch type covered 381,000 acres, but by 1973 it had declined to 234,200 acres. Probably the most important reason for the drop in this type is the reduction in the number and extent of forest fires in New Hampshire. This type, another pioneer type, can establish itself on relatively poor sites. Both of its common components—quaking aspen and paper birch—require open sunlight and mineral soil for seed germination and seedling development. They are natural occupants of sites where fire or other disturbances have destroyed or modified the organic soil layer.

Stand-Size Classes

Acreages in stand-size categories for 1948, 1960, and 1973 are not on the same basis, so differences do not necessarily represent actual trends.

The stand-size classes in New Hampshire are distributed about evenly. In 1973, 41 percent of the commercial forest land in the State was in sawtimber-size stands, 33 percent was in poletimber stands, and 26 percent was in seedling-and-sapling stands and nonstocked areas.

Although stand-size is evenly distributed among all forest types, it varies considerably among types. Sixty-two percent of the white pine/red pine type and 44 percent of the maple/beech/birch type is in sawtimber stands. By contrast only 22 percent of the elm/ash/red maple type and 27 percent of the spruce/fir type are in sawtimber-size stands. Past cutting practices associated with these types have probably contributed to these differences. Both white pine/red pine and maple/beech/birch are utilized mostly for sawtimber, so trees are allowed to attain larger sizes. Spruce/fir has been extensively utilized for pulpwood, so the diameter of each individual tree is not a major consideration. The explanation for elm/ash/red maple is somewhat different. In this type the low proportion of sawtimber stands may be due to the fact that the type occupies many poor sites where growth is slow.

Stocking and Area Condition

Ninety-four percent of the commercial forest land in New Hampshire is fully stocked or overstocked with trees of all kinds. This means that, on 94 percent of the commercial forest land, 100 percent or more of the optimum growing potential of the site is being utilized. At first glance this situation looks favorable.

But the rub comes when we consider only those trees that are considered growing stock. Only 54 percent of the commercial forest land is fully stocked or overstocked with growing-stock trees. This means that nearly half the commercial forest land in New Hampshire is not adequately stocked with potentially merchantable trees and that valuable growing space is occupied by inferior trees. A look at the numbers and classes of trees in New Hampshire's stands reinforces this conclusion. Of the 805 tree on the average acre of commercial forest land in New Hampshire, 275 trees—one in three—are classed as rough or rotten.

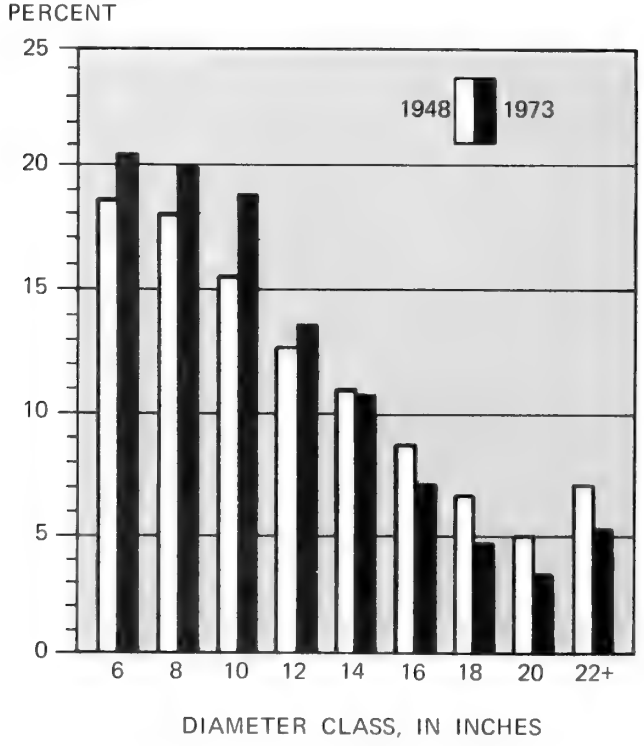
The average volume of growing stock per

acre of commercial forest land has risen 60 percent since 1948. In 1948 there were 878 cubic feet of growing stock on the average acre, and in 1973 there were 1,402. The volume of sawtimber per acre in New Hampshire also increased, although not as spectacularly as did all growing stock. In 1948 there were 2,014 board feet on the average acre; by 1973 the stocking had risen to 2,785, an increase of 38 percent. The biggest single cause for this increase in volume per acre is the decline in the rate of timber harvesting since 1948.

Timber Volume

Despite the fact that the area of commercial forest land has remained approximately constant since 1948, the volume of growing stock increased 60 percent during the 25-year period. Softwood volume gained 50 percent while hardwoods gained 70 percent. This substantial increase is the result of increasing stand density and a declining demand for timber during the 25-year period.

Figure 4.—Percentage of growing-stock volume in New Hampshire, by diameter classes, 1948 and 1973.



The total volume of growing stock in New Hampshire today stands at 6.6 billion cubic feet, compared with 4.1 in 1948 and 4.8 in 1960. Of the total, softwoods account for 3.1 billion cubic feet and hardwoods for 3.5 billion.

Sawtimber volume did not gain as much as the volume of growing stock gained. Total sawtimber volume rose from 9.4 billion board feet in 1948 to 13.1 billion in 1973, a gain of nearly 39 percent. Softwood sawtimber rose 34 percent from 5.7 billion board feet in 1948 to 7.6 in 1973. Hardwoods did somewhat better: they gained 45 percent, from 3.8 billion board feet in 1948 to 5.4 billion in 1973.

In addition to the 6.6 billion cubic feet of growing stock, there are 537 million cubic feet of sound wood in rough trees and another 327 million cubic feet in rotten trees. This is usable wood in trees that are either too crooked or too rotten to be classified as growing-stock trees. In New Hampshire nearly one tree in five over 5 inches dbh is a rough or rotten tree.

The distribution of growing-stock volume by diameter classes has changed somewhat since 1948. Today, a higher proportion of the volume is in trees 12 inches in diameter or smaller than was the case 25 years ago (fig. 4). This change can probably be traced to cutting practices that favor the harvesting of only the larger trees and the development of a high volume of red maple poletimber trees.

Sawlog Quality

The quality of hardwood logs in New Hampshire has declined primarily as a result of the decrease in average diameter of sawlog-size trees. In 1948 sawlog grade-1 and -2 logs accounted for 36 percent of the sawtimber inventory, but by 1973 the percentage had declined to 29 percent. In 1973, there were 519 million board feet in grade-1 hardwood logs and 1.0 billion board feet in grade-2 hardwood logs.

Hardwood sawlog grades are based on the number of potential clear cuttings in standard lumber logs and on the structural usefulness of timber-and-tie logs. Therefore the greater the proportion of volume in clear cuttings that can be expected from a log, the higher the grade. One factor that influences this potential yield

greatly is the diameter of the log. A grade-1 sawlog must have a minimum diameter inside bark at the small end of 13 inches. It is highly unlikely that a 14-inch dbh tree could contain such a log. In 1948, 55 percent of New Hampshire's sawtimber inventory was in trees larger than 14 inches, but by 1973 this proportion had dropped to 42 percent.

White and red pines were the only softwood species graded. Less than 2 percent of the sawtimber volume in these species was in grade-1 logs and 10 percent was in grade-2 logs. This extremely low proportion of high-quality white pine has two primary causes: heavy incidence of white-pine weevil attack throughout most of the State, and past harvesting practices that have favored the removal of only high-quality white pine while the poorer trees have been left to occupy growing space.

Volume by Species

The forests of New Hampshire contain a wide variety of species growing under an even wider variety of stand conditions. The variety of timber products produced in New Hampshire is just as diverse. Volume is the basis for judging the importance of a species for product use, and volume changes for a species can have important implications. For this reason a discussion of timber volume by

Figure 5.—Growing-stock volume in New Hampshire, by major species, 1948 and 1973.

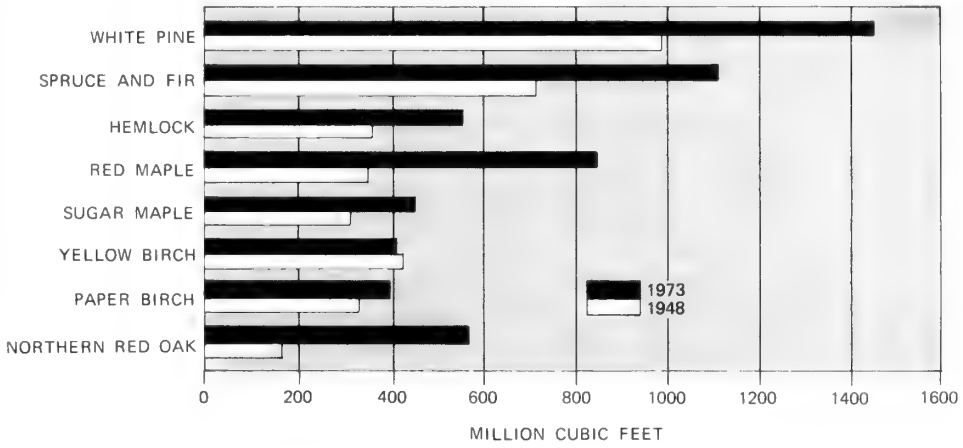
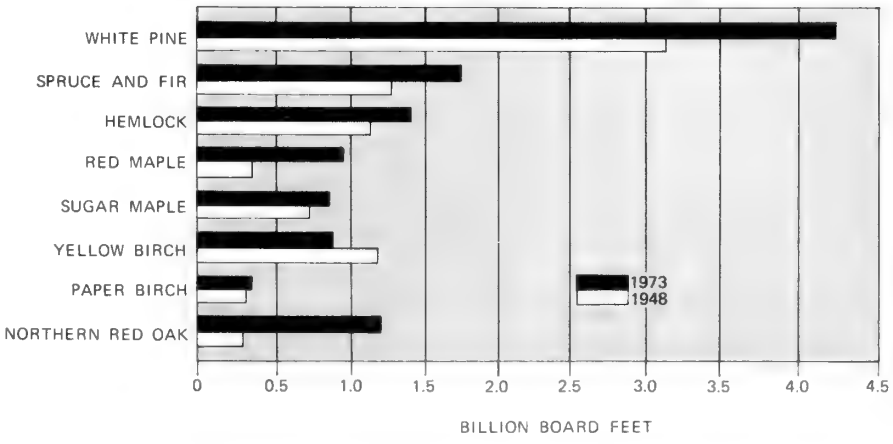


Figure 6.—Sawtimber volume in New Hampshire, by major species, 1948 and 1973.



major species is important. Figures 5 and 6 show a comparison of growing stock and sawtimber in 1948 and 1973, by major species.

White pine.—White pine is the most abundant species in New Hampshire, accounting for 1.5 billion cubic feet—up from less than 1 billion in 1948. White pine sawtimber volume also gained, but not as dramatically as did growing stock. In 1973 there were 4.3 billion board feet of white pine compared to 3.1 billion in 1948.

Although white pine is found throughout New Hampshire, it is most abundant in the southeastern quarter of the State and, to a lesser extent, along the Connecticut Valley in west central New Hampshire. Hillsborough, Merrimack, and Rockingham Counties have the largest concentrations of white pine. Throughout this region there are many sites with light, sandy, yet moist soils that are favorable to white pine development. Also in this region are many former farm fields that are in the process of reverting or have reverted to forest land. White pine frequently acts as a pioneer species under such conditions. Because of a lack of competition from surrounding trees, white pine frequently develops as short-boled and extremely limby individuals, known as "old-field pines". Such trees have limited value as lumber. About the only uses for old-field pines are pine novelties or rustic furniture.

White pine was once the mainstay of the New Hampshire lumber industry. In 1907 white pine lumber production reached its peak of 397 million board feet—53 percent of all the lumber produced in the State that year. By 1972 white pine sawlog production had dropped to 97 million board feet, although it still accounted for 53 percent of the State's sawlog production.

Spruce and fir.—Spruce and fir are the second most abundant species in the State. In 1973 these species accounted for 1.1 billion cubic feet of growing stock—up 53 percent from 711 million in 1948. Because of the generally small size of balsam fir and much of the spruce, together they accounted for only 1,787 million board feet of sawtimber.

Spruce and fir have been the staple raw material for New Hampshire's woodpulp industry. However, recent trends in this industry are toward a greater use of hardwood species for pulp. A recent high demand for spruce and fir studs has buoyed the demand for these species. In 1972, 11 percent of the sawlogs produced in New Hampshire were spruce and fir. These species accounted for more sawlog volume than any other species except white pine.

Hemlock.—The volume of hemlock growing stock has risen 57 percent since 1948, from 358 million cubic feet in 1948 to 546 million in 1973. Hemlock sawtimber did not do quite as well. It increased only 29 percent over the period, to 1.5 billion board feet. It is now the third most abundant sawtimber species, replacing yellow birch.

The increase in hemlock volume is a result of the increased density of forest stands in New Hampshire, plus a low demand for hemlock sawtimber. As stands become more dense, the shade-tolerant species become a more important component. Hemlock is one of the most shade-tolerant species and is a component or associate of the three most prevalent forest types in the State: maple/beech/birch, white pine, and spruce/fir.

Throughout most of the past 25 years, the demand for hemlock has been low. It is not a preferred species for pulping; and it is hard and somewhat brash, which makes it generally unsuitable for lumber except where strength is important. The rebirth of a stud industry in the Northeast may increase the demand for hemlock sawlogs.

Red maple.—The greatest increase in volume of the major species was the increase of red maple. Between 1948 and 1973 the growing-stock volume of red maple rose 146 percent. In 1948 red maple growing stock totaled 347 million cubic feet, but by 1973 it had risen to 855 million cubic feet. Red maple sawtimber volume rose 165 percent during the same period—from 369 million board feet to 978 million.

Though part of the increase in the elm/ash/red maple forest type can be attributed to changes in the method of determining forest types, the same cannot be said for the increase in the volume of red maple. Though red maple is the major component of the elm/

ash/red maple type, it is also a commonly associated species in all of the other major types found in New Hampshire. Red maple is not in much demand. Thus, harvesting practices that remove only those species in high demand, but leave such species as red maple, have contributed to the increase in the volume of red maple. As the use of hardwoods increases in woodpulp manufacture, and as the particle-board industry develops, maybe red maple will be utilized more extensively.

Sugar maple.—Of all the major species, sugar maple showed the smallest increase in volume. Sugar maple growing stock gained 44 percent during the 25-year period—from 313 million cubic feet in 1948 to 450 million in 1973. Sawtimber volume increased less—16 percent. In 1948 sawtimber sugar maple totaled 775 million board feet, and in 1973 it totaled 896 million board feet. A consistently high demand for sugar maple, particularly for furniture stock, has slowed the increase in volume of this species.

Yellow-birch.—Yellow birch was the only major species that decreased in volume. Growing-stock volume of yellow birch declined 4 percent, while sawtimber volume dropped 23 percent. In 1948 yellow birch growing stock totaled 433 million cubic feet, but by 1973 it was down to 416 million. In 1948 sawtimber volume stood at 1.2 billion board feet, and yellow birch was then the most abundant hardwood species in the State. By 1973 the volume had declined to 938 million board feet. Similar declines have been observed in Maine and Vermont.

Several factors have contributed to the decline in volume of yellow birch. Perhaps the most important was the high demand for yellow birch for veneer and turnery stock. Cutting practices that do not favor the regeneration of yellow birch have also contributed to the decrease in volume. In 1958-72 the average annual growth of yellow birch sawtimber was was 6.2 million board feet, while removals averaged 15.5 million board feet—a ratio of 2.5 to 1.

Paper birch.—The volume of paper birch growing stock rose 27 percent during the quarter century. In 1948 paper birch growing stock totaled 314 million cubic feet, and by 1973 it had risen to 400 million cubic feet. On the other hand, paper birch sawtimber rose a mere 3 percent during the period, from 339 to 349 million board feet. Paper birch, like yellow birch, is in great demand, particularly for furniture and cabinet stock and turnery bolts.

Northern red oak.—Once a relatively minor species in New Hampshire, northern red oak has become the second most abundant hardwood growing-stock species and the most abundant hardwood sawtimber species. In 1948 northern red oak growing stock totaled 164 million cubic feet, and by 1973 it had risen to 570 million. Red oak sawtimber rose from 308 million board feet to 1.2 billion—an increase of more than 300 percent.

The demand for northern red oak sawtimber in New Hampshire is, and has been, quite low. From 1958 to 1972, the average growth of red oak sawtimber exceeded average removals by more than 4.3 to 1. In earlier times, oak was used in shipbuilding and for heavy structural timbers. In recent decades the wood shipbuilding industry has all but disappeared, and heavy structural members are made either of steel or western timber species. Thus northern red oak has been left to grow.

Growth and Removals

To understand how the inventory changes, we compare the average annual growth with the average annual removal—how much growth of wood the trees put on versus how much volume was cut or otherwise lost.

The volume of growing stock in New Hampshire increased 2.5 billion cubic feet from 1948 to 1973, and sawtimber increased 3.6 billion board feet. This increase was due almost entirely to a decrease in the rate of harvesting. In 1948, 131.7 million cubic feet of growing stock were harvested, but in 1972 only 64.4 million were harvested. Net annual growth of growing stock was 3.6 percent of the inventory in both years—148.6 million cubic feet in 1948 and 236.3 million in 1972.

Cutting of sawtimber also declined, from 403 million board feet in 1948 to 166 million in 1972. The sawtimber growth rate rose from 3.4 percent to 4.1 percent in the 25-year per-

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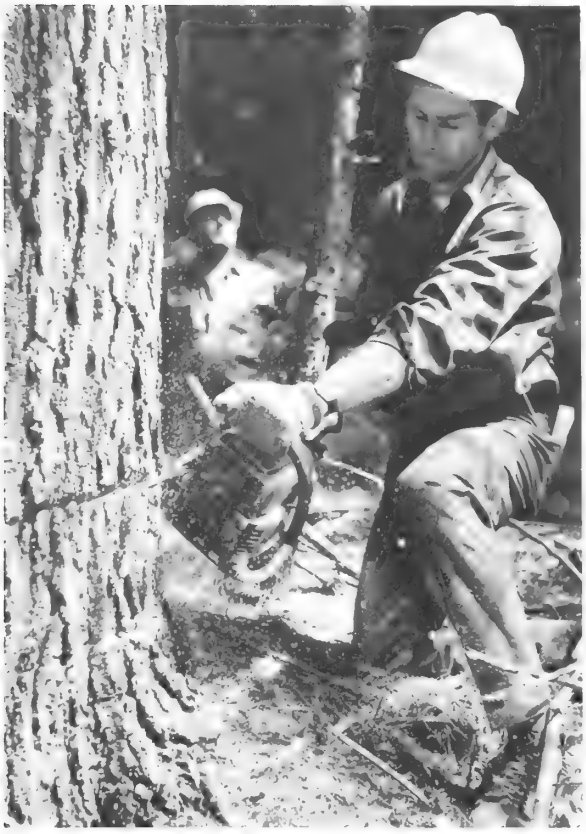


Starting the undercut.

iod. This increase indicates that there was a greater volume in large trees in 1973 than there was in 1948.

Change in the Inventory

The annual change in growing stock and sawtimber volume is equal to net growth less timber removal. Net growth is the sum of several factors. The first of these factors is growth on the initial inventory and ingrowth (the growth of trees that became large enough to be considered inventory). The sum of these is gross growth. Net growth is gross growth less changes in merchantability (cull-increment and mortality). It is the components of net annual growth that the forester seeks to manipulate through forest management.

An unusual change in any one of these factors can cause a substantial change in the annual inventory. For example, a sudden insect attack may increase mortality or cull increment. A sudden increase in timber demand may increase timber removal, which in turn would reduce the rate of increase in the inventory.

Because of changes in procedure since 1948, the components of annual change in the inventory can be broken out only for the 1958-72 period. For most species in New Hampshire, ingrowth is the most important component of growth. Of the average annual gross growth, this component accounted for 58 percent of the 252.1 million cubic feet. An important reason why ingrowth is such a large part of growth is the long period between surveys. As the interval between surveys increases, trees that were less than 5 inches in diameter at the initial inventory constitute a greater part of the average annual gross growth. Another factor is that timber removals usually take out the larger trees. In fact, for trees 17 inches dbh and larger, removals were more than three times the average annual growth in 1958-72.

Cull increment is the volume that became rough or rotten, and growing-stock mortality is the volume of growing-stock trees that have died since the previous inventory. Together, cull increment and mortality reduced gross growth by 18.9 percent. This is more than half as much as the average annual removal of growing stock during the period. The volume of each of the components of average annual net change in growing stock between 1958 and 1973 is shown below:

	Million cubic feet	*Percentage of gross growth*
Accretion (growth on surviving trees)	104.5	41.5
Ingrowth (volume and growth that became poletimber)	147.6	58.5
Gross growth	252.1	100.0
Cull-tree increment	− 26.9	− 10.7
Growing-stock mortality	− 20.6	− 8.2
Net growth	204.6	81.1
Removals	− 66.3	− 26.3
Net change in the inventory	138.4	54.9

Net Growth and Removal

Analysis of the trends in net annual growth of growing stock and in growing-stock removal

shows that removals have declined faster than net annual growth has increased. However, the decline in removal was not equally distributed between the two major species groups—softwoods and hardwoods. Cutting of softwoods has declined steadily from 92.1 million cubic feet in 1948 to 32.3 million in 1972. In 1948, growth of softwoods was only 77.0 million cubic feet, or 84 percent of removals. Growth of hardwoods, on the other hand, showed a slower rate of decline, and then swung up slightly in the last 2 years. At no time during the period did removals of hardwoods exceed net annual growth.

In 1972 the removal of growing stock as a percentage of net annual growth was about 20 to 30 percent. Two notable exceptions were yellow birch and red maple. The harvest of yellow birch growing stock was 129 percent of net annual growth, and removal of sawtimber was more than 123 percent of growth. Red maple has the lowest ratio of removal to growth of all major species—only 18 percent. The annual growth and removal of growing stock for the major species in New Hampshire are shown in figure 7.

Timber-product Output

The timber-product output estimates shown in tables 25 to 29 should not be confused with the estimates of annual timber removals shown in tables 20 and 21. Timber-product output is that portion of the total timber harvested that was used for products. In addition to timber removed for products, timber removals include logging residues and other removals such as those due to land-clearing, land-use changes, and so forth. In this section, data obtained from the New Hampshire Department of Resources and Economic Development, Division of Resources Development, and other data gathered as part of the resurvey, were used in analyzing the 1972 timber harvest and the output of timber products.

After 1830, lumber production in New Hampshire began to climb steadily, spurred on by the steam sawmill, railroads, and the emergence of large markets to the south. By 1869 the State was producing 253.4 million board feet of lumber (fig. 8). Most of this lumber was pine, hemlock, and spruce. Also,

Figure 7.—Annual growth and removal of growing stock in New Hampshire, 1972.

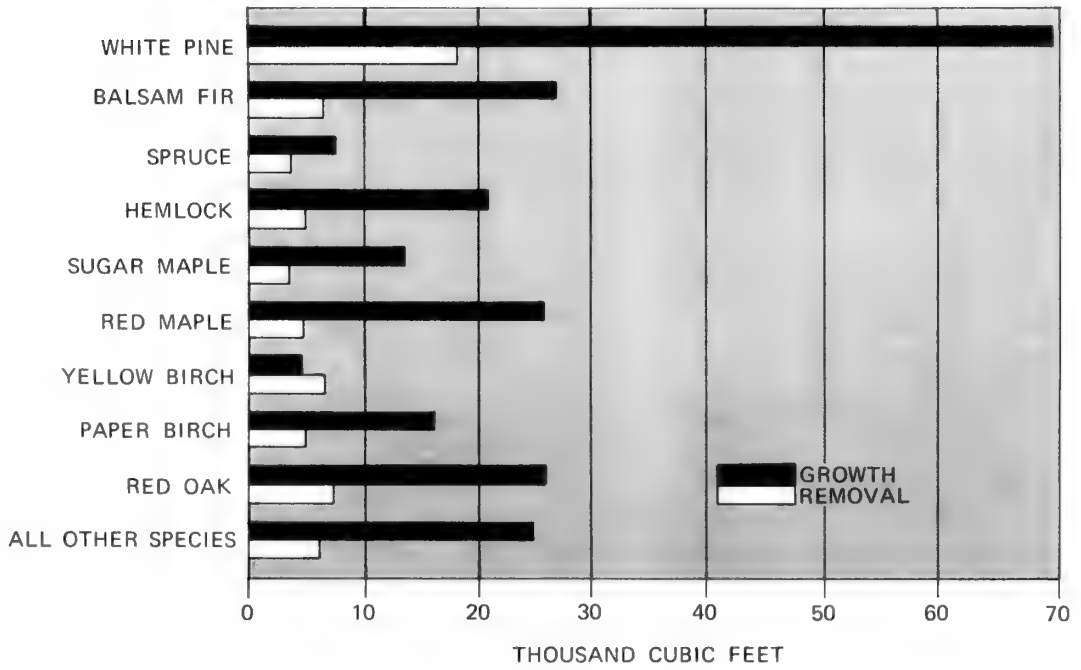
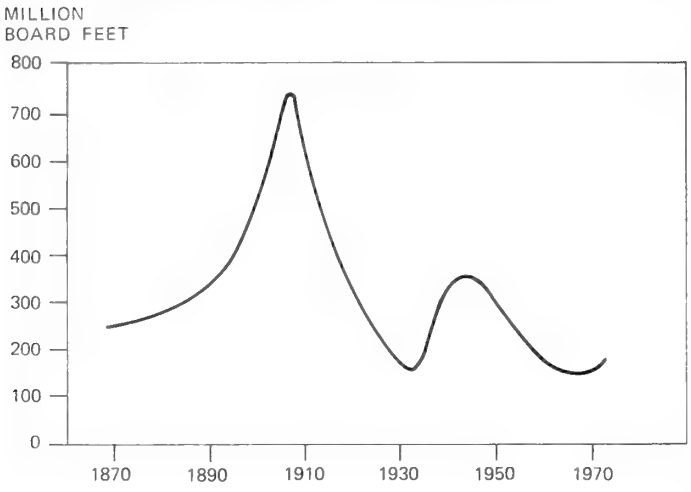


Figure 8.—The trend of lumber production in New Hampshire, 1869 to 1972.



about this time the use of wood for pulp was being developed in Massachusetts *(Kingsley 1971)*. By 1907 New Hampshire's lumber industry reached its peak production—754 million board feet *(Steer 1948)*. In the same year the youthful woodpulp industry consumed 430,000 cords. After 1907 the lumber industry began a general decline until it hit a bottom of 130 million board feet in 1932. After 1932 it began a slow recovery and then was spurred on by the timber-salvage operations after the 1938 hurricane and the demands of World War II. After World War II, production again slumped until in 1972 it stood at 182 million board feet.

The woodpulp industry continued to grow after 1907, only to be slowed by the depression and the development of a satisfactory means of pulping southern softwoods in the 1930s. Since World War II, New Hampshire has been steadily losing ground in pulpwood production because most of its mills cannot compete with the more modern and efficient mills of other regions. In 1972, pulpwood production stood at 311 thousand cords *(Bones and others 1974)*. The development of woodpulping methods that utilize hardwoods has spurred a modest recovery in the industry that may become substantial (fig. 9).

In 1972 New Hampshire had 185 primary wood-processing plants. These included 142 sawmills, 2 woodpulp mills, 16 wood-chipping plants, and 25 other plants that produced such products as specialty veneers, rustic fencing, cooperage, wood turnings, and excelsior (fig. 10). These plants, along with the other secondary wood-using plants, are an important segment of New Hampshire's economy. According to the 1967 Census of Manufactures, the wood-using industries in the State included 457 establishments that employed 12,700 people—13 percent of the State's manufacturing labor force *(U.S. Bureau of Census 1967)*. Only the leather and footwear industry and the electrical-equipment and supplies industry employed more people. The wood-using industries paid $71,900,000 in wages and salaries and accounted for $318,600,000 worth of goods manufactured in the State—19 percent of the State total. These industries included loggers, sawmills, planing mills, wood turners, furniture manufacturers, woodpulp mills, papermills, and many other firms that use wood in one form or another.

The harvest of forest products—sawlogs, pulpwood, and the like—also represents a substantial dollar return in the State. The 50.2

Figure 9.—The changing timber-products mix in New Hampshire, 1952-72.

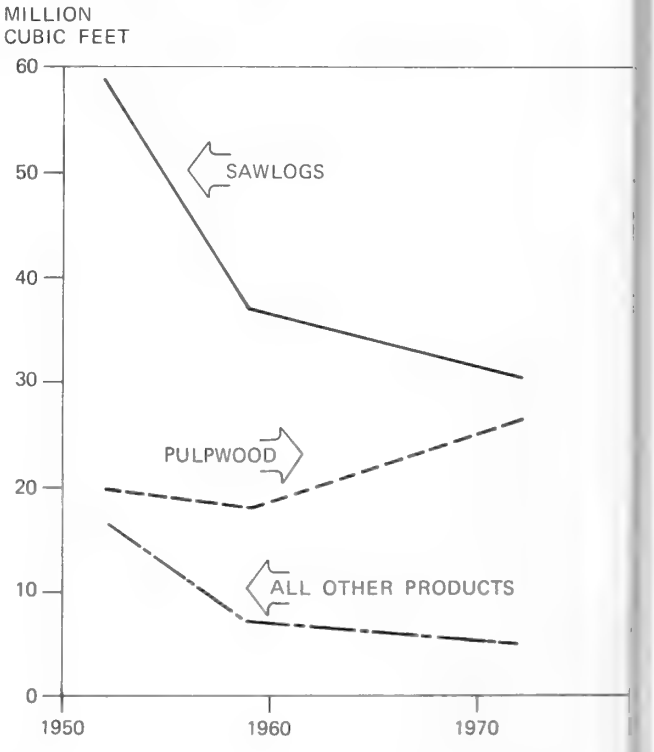
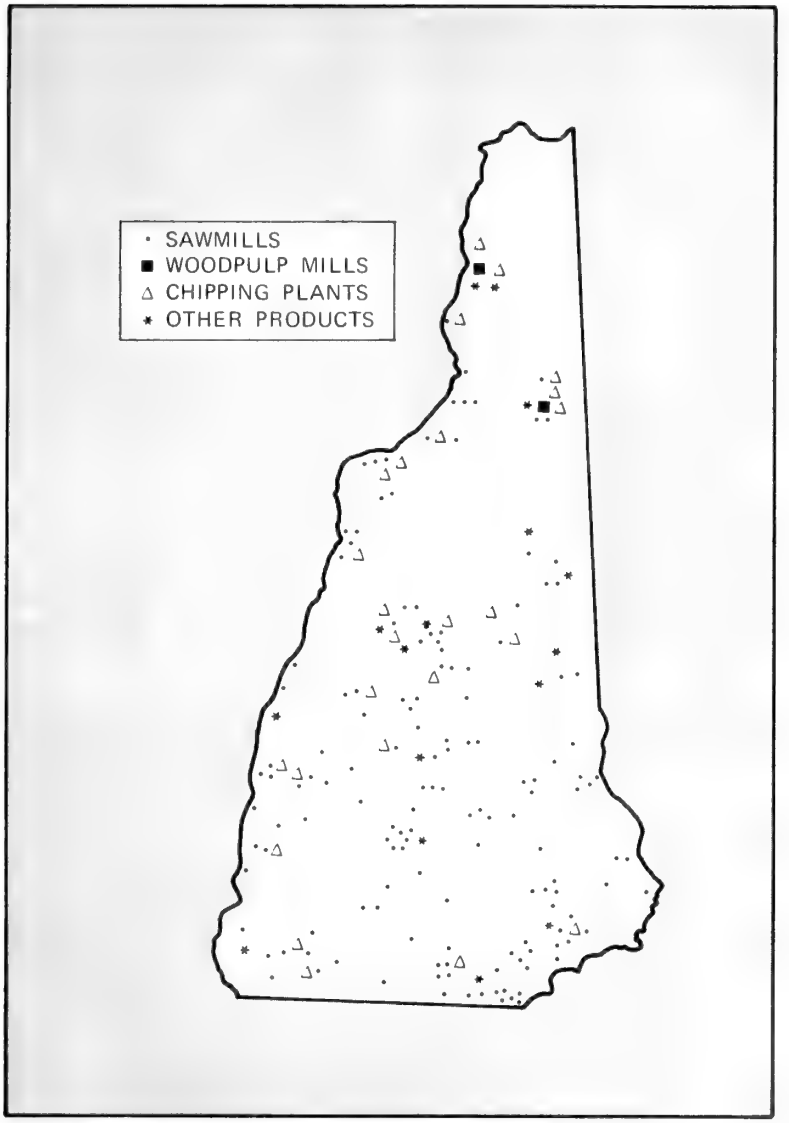


Figure 10.—Distribution of primary wood-processing plants in New Hampshire, 1972.



million cubic feet of timber that was harvested in 1972 is estimated to have had a value before it was harvested (stumpage value) of more than $5 million *(Engalichev and Sloan 1973)*. After it was harvested and delivered to the mill it had a value in excess of $21 million. To put this a different way: each acre of commercial forest land in New Hampshire supplied $1.07 worth of stumpage and $4.48 worth of delivered logs and bolts. This says nothing of the jobs provided, the potential capacity of the forest to produce timber, or of the other values this forest land supplied.

Sawlog Production

Sawlog production in New Hampshire stood at 182 million board feet in 1972. This was a 39-percent drop from the 1952 production of 297 million board feet. Although the total production of sawlogs in the State has declined, the decline has not been evenly distributed. In 1905, 90 percent of the sawlog harvest was softwoods, but by 1972 the softwoods accounted for 73 percent. For individual species, these changes are even more dramatic. In 1905, for instance, maple accounted for only 1 percent of the sawlog harvest; by 1972, it had

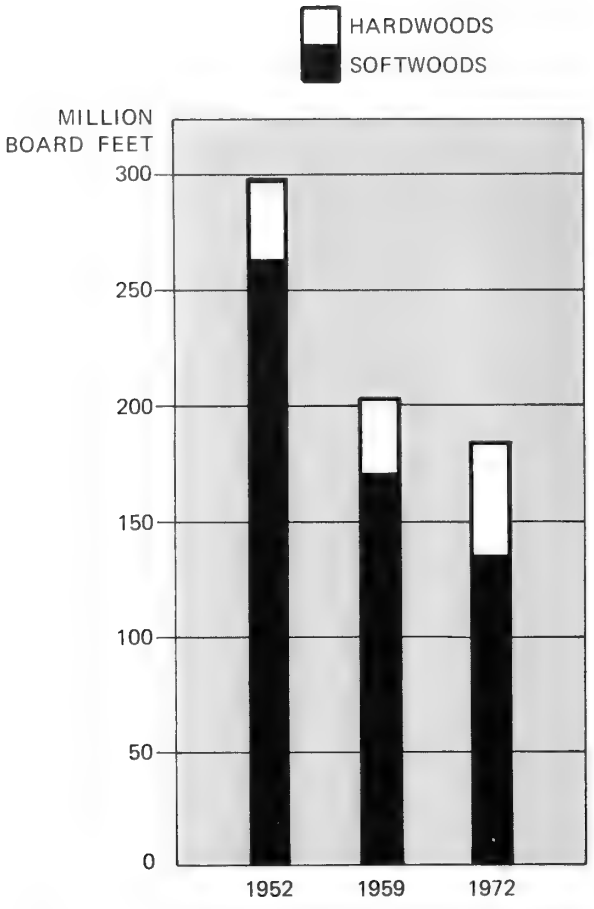


Figure 11.—Sawlog production in New Hampshire in 1952, 1959, and 1972.

risen to 9 percent. Because the total output of sawlogs has declined over this same period, the actual changes in output are even more dramatic (fig. 11).

Pulpwood Production

In 1972, pulpwood production in New Hampshire stood at 200,700 standard cords of round pulpwood. This represents a decline of 19 percent form the 1952 production of 247,500 cords. In addition, New Hampshire produced the equivalent of 110,700 cords as chipped residues from wood-using plants in 1972. These are primarily chipped sawmill slabs and edgings. In 1952 very little of the State's pulpwood output was in the form of chipped residues. Therefore, when we add this output of chips to the roundwood production, we find that total production actually increased somewhat over the 20-year period.

Another important change that has occurred is the shift to hardwood pulpwood, particularly roundwood (fig. 12). In 1959, 52 percent of the State's production of round pulpwood was softwood, principally spruce and fir. By 1972, the balance had shifted radically, and 68 percent of the round pulpwood was hardwood.

This change was fostered by the conversion of the woodpulp mills to pulping processes capable of utilizing a greater proportion of hardwood. In 1952, the two pulpmills in the State used the sulfite pulping process, which requires a high proportion of softwood. By 1972 both were using the sulfate (Kraft) process, which can utilize a high proportion of hardwood.

This change has not been restricted to New

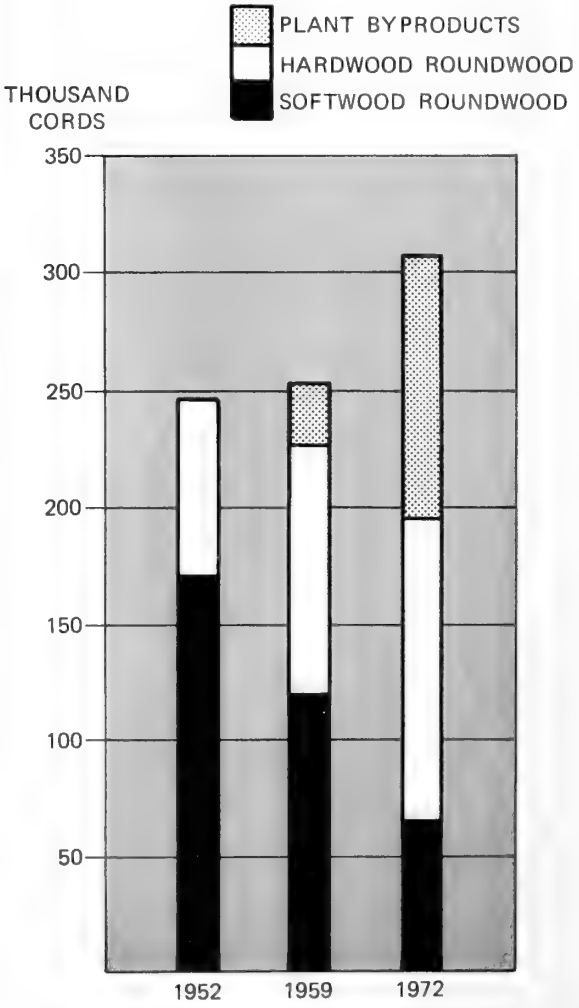


Figure 12.—Changing sources of pulpwood in New Hampshire in 1952, 1959, and 1972.

Hampshire. Sulfate pulpmill capacity in the 14 northeastern states rose from only 1,400 tons per day in 1955 to 5,900 tons per day in 1969, and the sulfate process is now the one most commonly used in the region *(Kingsley 1971)*. This shift to hardwood as a major source of pulpwood not only broadens the raw material base for the region's woodpulp mills, but also can have a long-term beneficial effect on the region's forests by providing a use for the large volumes of lower quality hardwoods that have built up over the years.

Veneer-Log Production

In 1952 New Hampshire had three veneer mills. By 1972 it had only one specialty veneer plant. During the same period, veneer-log production plummeted 85 percent—from 14.1 million board feet in 1952 to only 2.1 million in 1972. Today many veneer logs harvested in New Hampshire are shipped out-of-state for manufacturing, principally to Vermont.

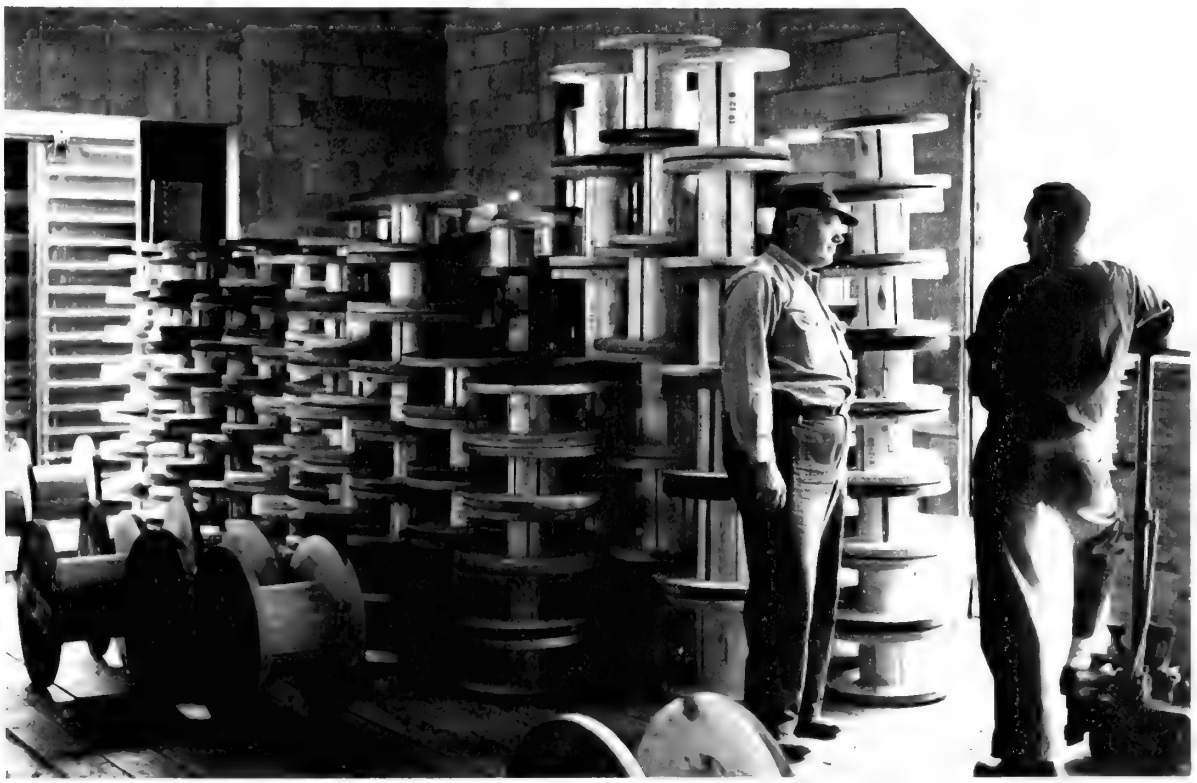
Yellow birch accounts for 51 percent of the New Hampshire veneer-log harvest. White birch is the second most commonly harvested: 16 percent. The remainder is composed of other hardwood species, mainly beech, hard maple, and oak. Small quantities of ash, soft maple, and other hardwoods are also harvested for veneer logs. In 1972, no softwood species were harvested for veneer logs in New Hampshire.

Other Products

Turnery bolts.—New Hampshire has several wood turneries. These mills primarily use bolts of yellow birch, white birch, and hard maple, from which they turn, rout, or shape blanks for products like paint-brush handles, chair legs, and spindles.

The textile bobbin industry was formerly an important segment of the wood-turning industry. This industry reached its heyday when New England was the center of the textile

Wood products from New Hampshire: wire-cable reels awaiting shipment.



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industry. After World War II, the textile industry moved south, and larger, faster textile machinery was developed that lessened the demand for bobbins. Thus both total bobbin production and the number of bobbin mills declined drastically. However, as yet there is no suitable substitute for the wooden bobbin made of birch or hard maple. This means that the bobbin industry will probably continue to be represented among the State's wood-based industries.

It is difficult to determine exactly how much material was consumed by the wood-turning industry. The reason for this is that most of the wood they use is harvested along with sawlogs and pulpwood and then is segregated out on the basis of its suitability for turnery bolts *(Kingsley 1973)*.

Excelsior.—The excelsior industry was once important in New Hampshire. In 1972, only one excelsior plant remained in the State. Excelsior (shredded wood, usually aspen) was once a popular padding material for shipping containers. The development of styrofoam padding has contributed much to the demise of this industry.

Other products.—New Hampshire now has only one producer of watertight white pine barrels. This industry was once an important supplier of barrels and kegs for shipping fish, butter, gunpowder, and anything else that required a watertight container. The remaining plant has recently been revitalized by turning to the manufacture of novelty cooperage products such as cigar kegs, ice buckets, and flower planters. In 1972 this 102-year-old plant produced 1,250 barrels and pails per day.

A newly developed industry in New Hampshire manufactures prefabricated log cabins. This industry has gained impetus from the development of the vacation-home business. Another somewhat similar industry produces rustic fencing; this industry uses mostly northern white-cedar logs and poles.

Fuelwood.—In 1972 New Hampshire produced 29,593 cords of fuelwood, nearly 19 thousand cords of which was roundwood. The remainder was residue from other industries. Most of the fuelwood produced—80 percent—and all of the roundwood, was hardwood. Little fuelwood is produced from growing stock. The majority comes from such sources as land-clearing, tops, limbs, shadetree removals, and sawmill slabs and edgings.

Nontimber Benefits of Forests

Though this report is concerned primarily with the growth and inventory of timber for timber products, the forests of the State provide many more goods and services. Many of these, however, never enter the market place; yet the quality of life in New Hampshire and for that matter most of New England is enriched by them.

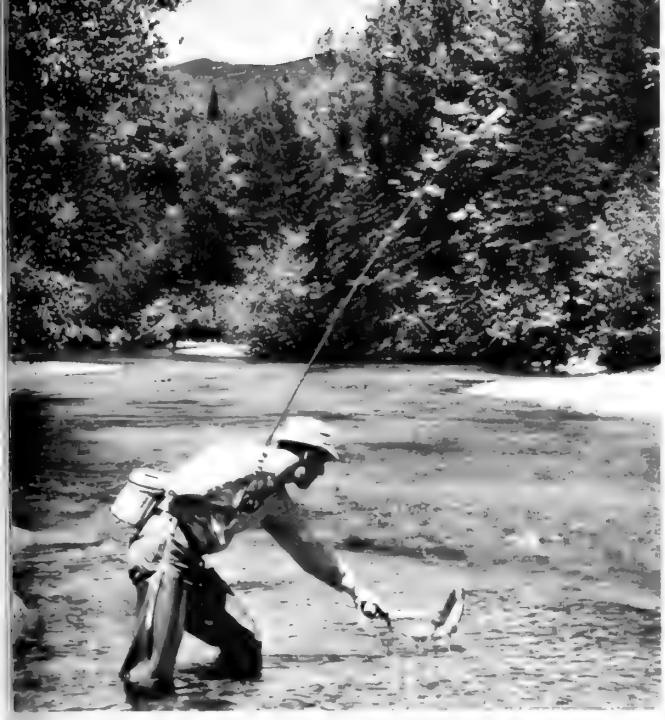
Water

New Hampshire contains all or parts of the headwaters of four major New England rivers —the Connecticut, Merrimack, Piscataqua, and Androscoggin. If the mountains of New Hampshire were not heavily forested, the major population centers downstream could expect periodic severe floods. In an average year, New Hampshire receives between 40 and 45 inches of precipitation, about half in the form of snow. Because the forest floor acts like a giant sponge to absorb this moisture and prevent excessive runoff, the differences between peak and low flows of New England's rivers are much less than they would otherwise be. Despite the forests, however, severe floods have occasionally occurred, particularly on the lower Connecticut and Merrimack Rivers. However, the addition of a few strategically located dams has substantially reduced the risk of catastrophic floods.

New Hampshire is well known for its many clear streams and lakes. It is the forest that is largely responsible for keeping them that way by controlling excessive runoff and sedimentation.

Recreation

The forest setting greatly enhances outdoor recreation in New Hampshire. Outdoor recreation—be it skiing, camping, fishing, hunting, hiking, or just plain sightseeing—has become a big business. Each year millions of people spend hundreds of millions of dollars for outdoor recreation in New Hampshire.



DICK SMITH PHOTO

Fishing in the Swift River. Few states have as many lakes, ponds, and streams of clear water as New Hampshire has.

In 1974, an estimated 3,816,097 people visited facilities operated by the New Hampshire Department of Resources and Economic Development, Division of Parks. These facilities include state parks, historic sites, ski areas, and public beaches.

There are more than 275 camping areas with a total of nearly 16,000 campsites in New Hampshire. These range from primitive areas for back-packers to highly developed sites with all the comforts of home. More than 5.5 million camper-days were spent in these 16,000 campsites in 1974. (A camper-day is any day or part of a day spent by a person while camping.) The State maintains 13 camping areas with a total of 923 campsites, and the White Mountain National Forest maintains 18 areas with 778 sites. The other sites are in privately-owned camp grounds. This industry had a phenomenal rate of growth during the late 1950s and early 60s, but has now, apparently, reached the more mature stage at which growth is much slower and the cost-price squeeze of intense competition has increased the failure rate.

New Hampshire and its sister state, Vermont, are usually credited with providing the best skiing east of the Rockies and west of the Alps. During the 1974-75 ski season an estimated 2.4 million skier-days were spent by skiing enthusiasts at the 24 developed ski areas in the State. At the two state parks where there are ski areas, nearly 200,000 skier days were recorded; and receipts totaled over $1.1 million.

Hunting and fishing are also important pastime pursuits in New Hampshire. In 1974, New Hampshire sold 197,656 hunting and fishing licenses: 43,745 hunting licenses, 114,-454 fishing licenses and 39,457 combination hunting and fishing licenses. In recent years hunters have spent an average of $31,481,430 annually. This is $18.28 for each of the 1,721,682 days spent in the field. Fishermen spend an average of $51,006,574 annually or $14.40 per day for 3,543,149 days. During the 1974 big-game season in New Hampshire, hunters shot 269 black bear and 6,917 white tailed deer. These two big-game species depend on a forest environment for food and shelter.

Wildlife

Because the forested lands of New Hampshire contain a great variety of forest site conditions, stand-sizes, and forest types, they provide habitat for a vast array of fauna and flora. In addition to game species like ruffed grouse, cottontail rabbits, varying hare, white tailed deer, and black bear, they host such species as the bald eagle, otter, moose, and bobcat. The State also porvides habitats for a number of the more spectacular songbirds like the indigo bunting, pine grosbeak, scarlet tanager, and cedar waxwing.

This varied habitat also provides many ecological niches for a large variety of herbaceous and woody plants. Rich soils under dense mature white pine stands support colonies of bluets, checkerberry, and trailing arbutus. Edges provide sites for serviceberry, and banks provide sites for hepatica or sumac.

There are close inter-relationships between plants and animals. Various cover types provide food and shelter and mating and rearing areas for wild animals. In turn animals help, through their feeding habits primarily, to disperse seeds of many species and to control competitive plant species. Often the inter-

N.H. DEPT. OF FISH & GAME PHOTOS

New Hampshire forests provide habitat for a great variety of wildlife—a black bear cub, a white-tailed deer fawn, and the nest of a ruffed grouse.

relationship may be so specific that elimination or substantial reduction in numbers of a single species of plant or animal may increase or decrease the numbers of another species.

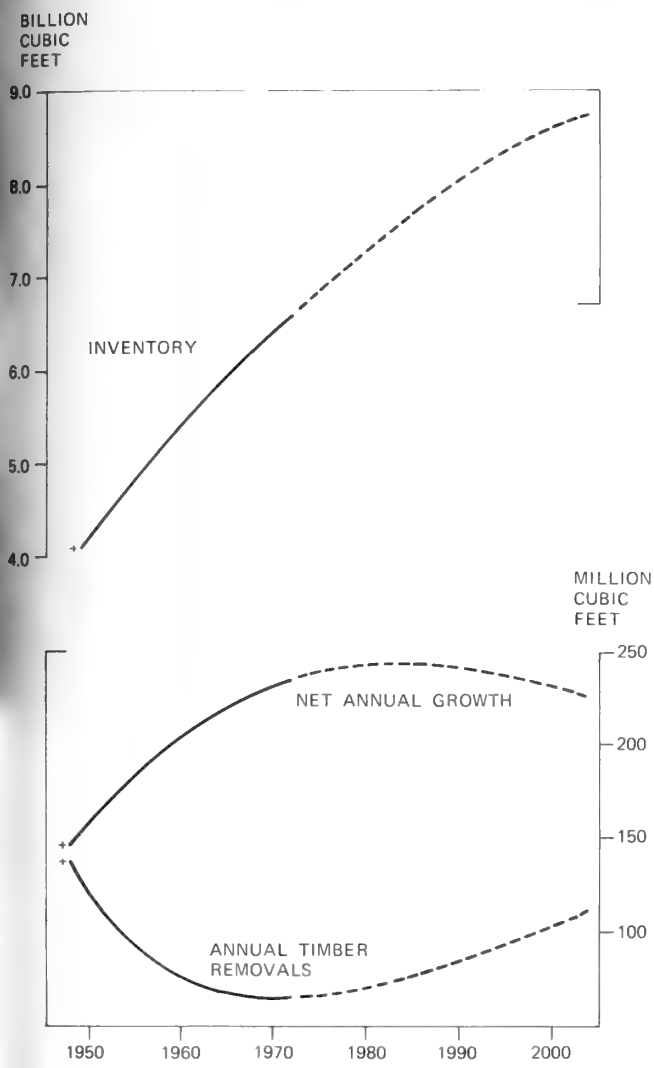
It is this varied forest cover, with its delicate mixture of life forms, that in large measure gives New Hampshire its appeal to tourists, sightseers, backpackers, skiers, and outdoor enthusiasts of all kinds. Other areas have mountains, lakes, snow, and trees; but in very few places in the world do they come together as they do in New Hampshire.

Timber Supply Outlook

The results of this forest survey of New Hampshire show that the total net annual growth of growing stock rose from 148.6 million cubic feet in 1948 to 236.3 million cubic feet in 1972. During this same period, annual timber removals dropped from 132 million cubic feet to 64.4 million cubic feet. This resulted in an increase in the growing stock of 51 percent. In 1948 the total growing-stock inventory stood at 4.1 billion cubic feet, and by 1973 it had reached nearly 6.6 million. During this same 25-year period, the commercial forest land area of the State at first increased, but it began to decline slowly during the 1960s. By 1973 the total commercial forest land area of the State stood at about the same level as in 1948—4.7 million acres.

With these past trends as prologue, we now confront the question of what might be expected to happen during the coming 30 years. In addition to the usual factors that make long-run projections risky, such as depressions and wars, the present economic and environmental situations further compound the prob-

Figure 13.—Projected growing-stock inventory, growth, and removals in New Hampshire to 2003.



lem. Will wood become an important source of fuel, replacing fossil fuels to some extent? Have petrochemical-based plastics and synthetic fibers had their day? If so, will this mean a return to the use of paper and wood? Will New Hampshire become even more of a mecca for those people who wish "to get away from it all"?

The answer to all these questions is a qualfied Yes. Given the apparent plight of the world's supply of fossil fuels, the long-term trend must be both away from their consumption and toward more efficient and less harmful use of what is consumed. And wood, because it is both abundant and renewable, seems to be a logical alternative source of energy.

Over the long run, New Hampshire will probably become more of a haven for recreationists as affluence increases and more leisure time becomes available. This will probably mean that more commercial forest land will be removed from timber production, either formally through governmental edicts or administrative decisions, or informally, through landowner attitudes that preclude timber production.

Since both of the above considerations tend to be somewhat counterbalancing, what might the future supply of timber be in New Hampshire in the coming years? In this projection it is assumed that the area of commercial forest land will continue to decline gradually over the next 30 years for a total loss of nearly 500,000 acres. All indications are that timber removals reached their nadir in 1972. Pulpwood production was up in 1973 and again in 1974. Much of the recent decline in timber removals has been the result of restructuring in the major wood-using industries in the region, and indications are that removals will show a gradual upswing as the industry develops to fully utilize available growth.

The rate of increase in timber removals is not expected to affect the increase in net annual growth (fig. 13). Consequently, the total inventory of growing stock is expected to increase over the period. Over the projection period, the average volume of growing stock per acre of commercial forest land in New Hampshire is expected to increase from the present 1,402 cubic feet to 2,072 cubic feet in the year 2003. This means that growth per acre will increase from the present average of about 50 cubic feet per acre to a maximum of 54 cubic feet about 1990 and then hold constant for the next 12 years.

The reason why net annual growth is not expected to increase beyond 54 cubic feet is twofold. First, it is assumed that the level of forest management will not be significantly increased statewide by 1990. Second, about 1990 the optimum level of stocking will have been reached, and any further increase in stocking will not affect a consequent increase in growth per acre. This fact, coupled with the expected

decrease in the acreage of commercial forest land, is reflected in both the total net annual growth curve and the total inventory curve. Thus, total net annual growth will continue to increase, but at a decreasing rate, to a maximum of about 245 million cubic feet in 1983 and then decline to 230 by 2003. Similarly, the total inventory will also increase, but at a slightly decreasing rate. Total inventory will rise from 6.6 billion cubic feet in 1973 to 8.7 billion in 2003.

Opportunities for Forest Management

A cursory examination of the results of this third forest survey of New Hampshire would indicate that the forests of the State are in relatively good condition. Growing-stock volume per acre is nearly optimum. The distribution of stand-size classes is perhaps a little beyond what most foresters would consider optimum. Sawtimber-size stands account for more than 41 percent of the commercial forest land, poletimber size 33 percent, and sapling-and-seedling stands and nonstocked areas 25 percent. The relatively higher proportion of stands in the sawtimber-size class is largely the result of reduced timber-harvesting.

Closer examination of the results of this survey reveal several problems. Foremost among these is the changing species mix in the State. The high-value species such as sugar maple, yellow birch, and white birch have not increased in volume as greatly as have the lower valued species like red maple and northern red oak. The major reason for this is that timber markets, and therefore timber-harvesting practices, have favored the removal of high-value species while less desirable species have been left to grow and occupy space.

Another continuing problem is timber quality. Of all hardwood trees over 5 inches dbh, 22 percent are either too rough or too rotten to be considered as growing-stock trees. When we look at sawlog quality, we find that 71 percent of the hardwood sawlog volume in the State is in standard lumber log-grade-3 or poorer.

The softwood quality picture looks substantially better, until one takes into account that, for most softwood species in the State, quality is not as important a consideration as for hardwoods. But the one softwood species for which quality is a major consideration, white pine, presents a dismal picture. Only 1 percent of the white pine sawtimber volume in New Hampshire is in grade-1 logs, and 89 percent is in grade-3 or poorer logs.

At this point the reader may be tempted to ask: "Why be concerned about forest management? Hasn't timber demand been low, and isn't it expected to remain less than growth for the next 30 years?" Though this is true, it should be kept in mind that one factor contributing to the lower levels of timber harvesting has been the declining quality and productivity of the resource. All indications point to a substantially increased worldwide demand for timber. New Hampshire, with its nearly 5 million acres of forest land, will be expected to help meet these increased demands. Because timber-growing is a long-term venture, work should begin now on producing a greater supply of timber.

Many stands in New Hampshire have been harvested repeatedly by a type of timber harvesting in which only the most marketable trees were removed, and little if any thought was given to the composition or condition of future timber stands. It is primarily this practice that is responsible for the poor quality of today's stands. To realize the full productive potential of timber stands, and also to maintain a healthy forest, timber stands must be managed.

The results of the forest survey show that New Hampshire's forest resources cannot be described easily in broad terms. Different stand conditions, ownership objectives, timber markets, and many other factors dictate the management needs of individual stands or tracts of forest land. Therefore forest management is best carried out on a tract-by-tract basis by professional foresters. For these reasons we must consider the management of New Hamphire's three most important forest types —white pine, northern hardwoods, and spruce-fir separately.

Management of Eastern White Pine

The worst enemy of white pine in New Hampshire is the white-pine weevil *Pissodes strobi* (Peck). This insect attacks and kills the terminal shoot of the tree. Though this injury almost never kills the tree, it does cause excessive sweep and crook, as lateral branches compete for the position formerly held by the terminal shoot or leader. The rapidity with which one lateral shoot asserts dominance over the others determines the degree of the crook. In some cases two laterals compete long enough to establish a forked tree. In addition to causing crook, weevil injury also causes a loss in stem length, affecting 2 or 3 years of growth. Lumber defects caused by weevil injury are cross-grain, large branch knots, and loose knots. Weevil injury generally reduces board quality by one grade and occasionally by as much as three grades. In addition, weevil injuries often provide an infection court for red rot.

There are several ways to minimize weevil damage, but no practical way to eliminate it entirely. Chemical spraying can be used, but this is very expensive because it must be applied repeatedly from the ground. A silvicultural system that includes one or more of the following prescriptions seems to be the best compromise between effectiveness and economy:

- Because the weevil is attracted most to leaders that are exposed to open sunlight, white pines less than 20 feet tall should be kept shaded beneath an overstory of hardwoods.
- Maintain high density in young pine stands. This does not reduce the incidence of weevil damage, but those trees that are weeviled tend to straighten out more rapidly, and the effect of the injury is minimized.
- Intermix pine with other species, particularly hardwoods. This helps to reduce large extensive areas of pine that might permit the buildup of heavy weevil infestations. Also, such interspersion adds a shading effect.

Another problem in white pine management is the persistence of dead branches. Because of this characteristic, any program of management to produce high-quality white pine must include a program of pruning. Frequent pruning keeps knots small and helps to upgrade the lumber yield.

Because production of quality white pine can be an expensive and time-consuming job, the forest manager should select only the better sites and manage these intensively for quality production rather than attempt less than full treatment of all the stands available to him.

UNIV. N.H. COOPERATIVE EXTENSION SERVICE PHOTO

Production of quality white pine sawlogs requires frequent pruning.

Spruce/Fir Management

Successful regeneration is the principal management problem of this type. Although the type is amenable to nearly all regeneration systems, the choice of the proper regeneration system to fit a particular set of circumstances is critical *(Gibbs 1973)* because of the type's susceptibility to windthrow.

One silvicultural system that is increasingly used, and often misunderstood, is clearcutting. This system is best applied to even-aged mature or overmature stands where windthrow of residual trees would be a problem. Generally, clearcut areas should be in strips or small patches to provide shade for advance reproduction and a source of seed from the adjacent stand *(Frank and Bjorkbom 1973)*. Such clearcut patches benefit wildlife by providing openings and edges for food, cover, and browse. Large clearcut areas frequently produce soil-surface temperatures that are too high for successful germination of spruce and fir seed.

In recent years there has been considerable public controversy about use of this system. There can be no denying that a recently clearcut area looks bad. However, it is just such exposure of the mineral soil that is essential to successful seed germination of the major species in this type. When this system is properly applied, seeds will germinate without an inhibiting overstory, accumulated brush, or erosion.

In the past some public criticism of this regeneration system has been justified. Too often exploitive harvesting has masqueraded as clearcutting. In these instances clearcut areas were too large or on steep slopes, or too much logging debris was left in the area for effective regeneration. On some areas only the desired species were harvested, leaving less desirable trees to grow and develop into an overstory that inhibited the development of the new stand and dominated the site. Properly applied, silvicultural clearcutting requires that all stems of whatever species over 2 inches in diameter be removed in order that these stems do not dominate the site *(Frank and Bjorkbom 1973)*.

The selection system of silviculture, used to develop or maintain an uneven-aged forest, includes some form of periodic harvests. With this system it is very important to plan periodic harvests to assure a desirable mix of ages and diameter classes. The selection system may take the form of single-tree selection or group selection, sometimes called patch cutting. The diameter-limit system of harvesting, in which only trees over a specified diameter are removed, is a modified form of selection harvesting. A drawback to this system is that too strict an adherence to the diameter limit may result in a residual stand in which too few stems are removed in some areas while too many are removed in others.

In the shelterwood system two cuttings are undertaken to remove the harvestable stand. With this system, up to half of the basal area of the stand can be removed in the initial harvest. The residual stand provides a source of seed for the new stand, as well as partial shade and protection for the young stand underneath. The shelterwood system should not be used where windthrow is a problem.

Northern Hardwood Management

No other major forest type in New Hampshire has been subjected to such a lack of proper forest management as has this type. There are several reasons for this. Because the type is composed of a vast array of species, some of which are highly valued and others of little value commercially, many stands have been high-graded repeatedly. This means that only the marketable stems have been harvested, while those of poor quality or undesirable species are left to grow. It is this practice that is in large part responsible for the conversion of many maple/beech/birch stands to elm/ash/red maple.

Because few hard and fast rules apply to the management of this type, in approaching the management of northern hardwood stands the professional forester must call up considerable judgment and expertise. He must consider, in addition to the owner's objectives, the condition and species composition of the present stand, the browse pressure of the indigenous deer herd, the size of the trees, the age of the stand, and the site. All these factors will play important roles in choosing which silvicultural treatments to apply.

Should he desire to perpetuate such shade-tolerant species as sugar maple, beech, hemlock, or red spruce, the forester may choose the selection system *(Filip and Leak 1973)*. This is also a desirable system in which recreation, esthetics, or overbrowsing by deer may be considerations. It is important that the resulting stand be given several cuts in order to develop the desired distribution of ages, species, and sizes.

Wherever intermediate or light demanding species are desired, some form of even-aged silviculture—either clearcutting or a shelterwood system—will be chosen *(Filip and Leak 1973)*. Where white birch or yellow birch is desired, it is often necessary to clearcut and scarify the seedbed to assure successful germination of seed. The need of harvesting systems that would scarify the seedbed has played a significant role in the decrease of yellow birch in many areas of the State.

Stands that are heavily diseased should be clearcut and regenerated. Conversely, in areas with high deer populations, excessive browsing can damage or even eliminate reproduction entirely in clearcut areas.

Forest Protection

An essential function of forest management is to protect the forest from its three natural enemies: fire, insects, and disease. Because these enemies don't respect property lines, the major effort of combating them is a governmental responsibility.

Although the incidence of fires in New Hampshire has not declined in recent decades, the area burned annually has been reduced substantially. In 1972, there were 431 forest fires in the State. Of these, 377 burned less than ¼ acre, and only one burned more than 100 acres. This is the result of quick and effective fire suppression. Of the fires 1971-72, only 2 percent were caused by lightning; the other 98 percent were man-caused. Smoking and children accounted for 45 percent. These facts attest to the need for a constant public education campaign *(N.H. Dep. Resour. and Econ. Dev. 1973)*.

Several insects are factors to be dealt with in the management of New Hampshire forests. The white-pine weevil has been discussed earlier as a major factor in white pine management. Other insects include the sugar maple borer *Glycobius speciosus* (Say). This insect breeds in the tissues of fresh wounds on maples. The gypsy moth Porthetria dispar (L), which has been causing extensive damage in other states, is on the decline in New Hampshire.

Among the important diseases, perhaps the most important is white pine blister rust *Cronartium ribicola* (Fisch). Another is beech bark disease. This is not caused by a single organism but by a complex of fungi and insects. The principal culprits are the fungus *Nectria coccinea* var. *faginata* Loh., Wats., and Ay and several other fungi. The fungi enter the bark through small eruptions made by the scale insects *Cryptococcus fagi* Baer and *Xylococculus betulae* (Perg.) Morris. This complex is eventually lethal.

Air pollution is becoming increasingly a problem for white pine. Experts believe that high concentrations of ozone in the ambient air cause needle blight, emergence tip burn, or needle tissue blight.

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Appendix

I
DEFINITION OF TERMS

Land Area Classes

Land area.—(a) Bureau of the Census: the area of dry land and land that is temporarily or partly covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, estuaries, and canals that are less than ⅛ statute mile in width; and lakes, reservoirs, and ponds that are less than 40 acres in area. (b) Forest Survey: the same as the Bureau of the Census, except that the minimum width of streams, etc., is 120 feet, and the minimum size of lakes, etc., is 1 acre.

Forest land.—Land that is at least 16.7 percent stocked (contains at least 7.5 square feet of basal area) by forest trees of any size or that formerly had such tree cover and is not currently developed for nonforest use. (Forest trees are woody plants that have a well-developed stem and usually are more than 12 feet in height at maturity.) The minimum area for classification of forest land is 1 acre.

Commercial forest land.—Forest land that is producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and is not withdrawn from timber utilization. (Industrial wood: all roundwood products, except fuelwood.)

Noncommercial forest land.—Forest land that is incapable of yielding timber crops because of adverse site conditions (unproductive forest land), and productive forest land that is withdrawn from commercial timber use (productive-reserved forest land).

Productive-reserved forest land.—Forest land that is sufficiently productive to qualify as commercial forest land, but is withdrawn from timber utilization through statute, administrative designation, or exclusive use for Christmas-tree production.

Unproductive forest land.—Forest land that is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions, because of adverse site conditions.

Nonforest land.—Land that has never supported forests, and land formerly forested but now in nonforest use such as for crops, improved pasture, residential areas, and the like.

Ownership Classes

National Forest.—Federal lands that have been legally designated as National Forests or purchase units and other lands that are under the administration of the Forest Service.

Federal.—Lands (other than National Forests) that are administered by Federal agencies.

State.—Lands that are owned by the State of New Hampshire or leased to the State for 50 years or more.

County and municipal.—Lands that are owned by counties and local public agencies or municipalities or leased to them for 50 years or more.

Forest industry.—Lands that are owned by companies or individuals operating wood-using plants.

Farmer-owned.—Lands that are owned by farm operators, whether part of the farmstead or not. Excludes land leased by farm operators from nonfarm owners.

Miscellaneous private.—Privately owned lands other than forest-industry and farmer-owned lands.

Stand-size Classes

Stand.—A growth of trees (see definition under "Tree Classes") on a minimum of 1 acre of forest land that is at least 16.7 percent stocked by forest trees of any size.

Sawtimber stands.—Stands that are at least 16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and in which sawtimber stocking is at least equal to poletimber stocking.

Poletimber stands.—Stands that are at least 16.7 percent stocked with growing-stock trees of which half or more of this stocking is in poletimber and/or sawtimber trees in which poletimber stocking exceeds that of sawtimber.

Sapling-seedling stands.—Stands that are at least 16.7 percent stocked with growing-stock trees of which more than half of the stocking is saplings and/or seedlings.

Nonstocked areas.—Commercial forest land that is less than 16.7 percent stocked with growing-stock trees.

Stocking Classes

Stocking.—The degree of occupancy of land by trees, measured in terms of basal area of trees in a stand compared to the basal area of trees required to utilize fully the growth potential of the land. The actual stocking at a point was evaluated against a standard of 75 square feet of basal area per acre (see definition of basal area under "Tree Measurement and Volume"). The stocking percentage for a sample plot is derived from the stocking for each of 10 points. Three categories of stocking are used:

All live trees.—These are used in the classification of forest land and forest types.

Growing-stock trees.—These are used in the classification of stand-size classes.

Desirable trees.—These are used in the classification of area-condition classes.

The degree of plot stocking is viewed as a range of values rather than single points. A fully stocked

stand lies within the range of 100 to 133 percent of the basal-area standard. An overstocked stand contains more than 133 percent. The range for medium stocking is 60 to 100 percent and for poor stocking is 16.7 to 60 percent of the basal-area standard. Forest land with less than 16.7 percent of the basal-area standard is classed as nonstocked.

Tree Classes

Forest trees.—Woody plants that have well-developed stems and usually are more than 12 feet in height at maturity.

Commercial species.—Tree species that are presently or prospectively suitable for industrial wood products. Excludes species of typically small size, poor form, or inferior quality, such as hawthorn and sumac.

Growing-stock trees.—Live trees of commercial species that are classified as sawtimber, poletimber, saplings, and seedlings; that is, all live trees of commercial species except rough and rotten trees. (See definitions under "Class of timber".)

Acceptable trees.—Growing-stock trees of commercial species that meet specified standards of size and quality, but do not qualify as desirable trees.

Desirable trees.—Growing-stock trees of commercial species, (a) that have no serious quality defects that limit present or prospective use for timber products, (b) that are of relatively high vigor, and (c) that contain no pathogens that may result in death or serious deterioration before rotation age.

Rotten trees.—Live trees of commercial species that do not contain at least one 12-foot sawlog or two noncontiguous sawlogs, each 8 feet or longer, now or prospectively, and do not meet regional specifications for freedom from defect primarily because of rot; that is, when more than 50 percent of the cull volume in a tree is rotten.

Rough trees.—(a) The same as above, except that rough trees do not meet regional specifications for freedom from defect primarily because of roughness or poor form, and (b) all live trees that are of noncommercial species.

Site-quality Classes

Site class.—A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Classifications are based upon the mean annual growth of growing stock attainable in fully stocked natural stands at culmination of mean annual growth.

Forest Types

Forest type is a classification of forest land based upon the species forming a plurality of live-tree stocking. The many local forest types in New Hampshire were combined into the following major forest types:

White pine/red pine/hemlock.—Forests in which eastern white pine, red pine, or hemlock, singly or in combination, make up a plurality of the stocking. (Common associates include aspen, birch, and maple.)

Spruce/fir.—Forests in which spruce or balsam fir, singly or in combination, make up a plurality of the stocking. Cedar swamps are also in this type. (Common associates include white-cedar, tamarack, maple, birch, and hemlock.)

Pitch pine.—Forests in which pitch pine comprises a plurality of the stocking. (Common associates include oaks.)

Oak/pine.—Forests in which hardwoods (usually red or black oaks) comprise a plurality of the stocking, but in which pines comprise 25 to 30 percent of the stocking.

Oak/hickory.—Forests in which oaks, singly or in combination, make up a plurality of the stocking, except where pines make up 25 to 50 percent, in which case the stand would be classified as oak/pine. Hickory is seldom present in New Hampshire. (Common associates include elm and the maples.)

Elm/ash/red maple.—Forests in which elm, ash, or red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include beech, white pine, basswood, and sugar maple.)

Maple/beech/birch.—Forests in which sugar maple, beech, or yellow birch, singly or in combination, comprises a plurality of the stocking. (Common associates include hemlock, elm, basswood, white pine, white birch and red maple.) Also called northern hardwoods.

Aspen/birch.—Forests in which aspen, balsam poplar, paper birch, or gray birch, singly or in combination, comprise a plurality of the stocking. (Common associates include red maple and balsam fir.)

Class of Timber

Softwoods.—Coniferous trees that are usually evergreen, having needles or scale-like leaves.

Hardwoods.—Dicotyledonous trees that are usually broad-leaved and deciduous.

Sawtimber trees.—Live trees of commercial species, (a) that are of the following minimum diameters at breast height—softwoods 9.0 inches and hardwoods 11.0 inches; and (b) that contain at least one 12-foot merchantable sawlog or two noncontiguous 8-foot merchantable sawlogs, and meet regional specifications for freedom from defect.

Poletimber trees.—Live trees of commercial species that meet regional specifications of soundness and form, and are at least 5.0 inches dbh but are smaller than sawtimber size.

Saplings.—Live trees of commercial species that are 1.0 to 5.0 inches in diameter at breast height and of good form and vigor.

Seedlings.—Live trees of commercial species that are less than 1.0 inch in diameter at breast height and are expected to survive.

Rough and rotten trees.—See definitions under "Tree Classes".

Timber Measurement and Volume

Basal area.—The area in square feet of the cross-section at breast height of a single tree, or of all the trees in a stand, usually expressed as square feet of basal area per acre.

Board foot.—A unit of lumber measurement 1 foot long, 1 foot wide, and 1 inch thick, or its equivalent. By forest-survey convention, softwoods less than 9.0 inches dbh and hardwoods less than 11.0 inches dbh do not contain board-foot volume.

Diameter at breast height (dbh).—The diameter outside bark of a standing tree measured at 4½ feet above the ground.

Growing-stock volume.—Net volume, in cubic feet, of live growing-stock trees that are 5.0 inches dbh and larger, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem, or to the point where the central stem breaks into limbs. Net volume equals gross volume less deduction for rot.

International ¼-inch rule.—A log rule, or formula, for estimating the board-foot volume of logs. Stated mathematically, the formula is $[\{D^2 \times 0.22\} - 0.71\ D] \times 0.904762$ for 4-foot sections, where D = the diameter inside bark at the small end of the 4-foot section. The International ¼-inch rule is used as the USDA Forest Service standard log rule in the northeastern United States.

Standard cord.—A unit of measure for stacked bolts of wood, encompassing 128 cubic feet of wood, bark, and air space. Cord estimates can be derived from cubic-foot estimates of growing stock by applying an average factor of 80 cubic feet of wood (inside bark) per rough cord.

Sawtimber volume.—Net volume in board feet, International ¼-inch rule, of merchantable sawlogs in live sawtimber trees. Net volume equals gross volume less deductions for rot, sweep, and other defects that affect use for lumber.

Sawlog.—A log that meets minimum standards of diameter, length, and defect, including logs at least 8 feet long, and with a minimum diameter inside bark of 6 inches for softwoods and 8 inches for hardwoods. (See specifications under "Log Grade Classification".)

Sawlog portion.—That part of the bole of a sawtimber tree between the stump and the sawlog top (merchantable height).

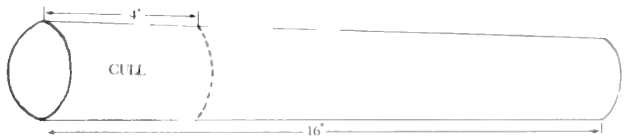
Sawlog top.—The point on the bole of a sawtimber tree above which a sawlog cannot be produced. The minimum sawlog top is 7.0 inches d.o.b. (diameter outside bark) for softwoods and 9.0 inches d.o.b. for hardwoods.

Upper-stem portion.—That part of the main stem or fork of a sawtimber tree above the sawlog top to a diameter of 4.0 inches outside bark or to the point where the main stem or fork breaks into limbs.

Log-Grade Classification

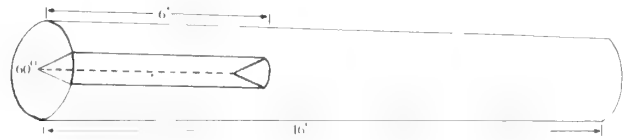
Methods of determining scaling deduction.

(Examples based on a 16-foot log with 20-inch scaling diameter



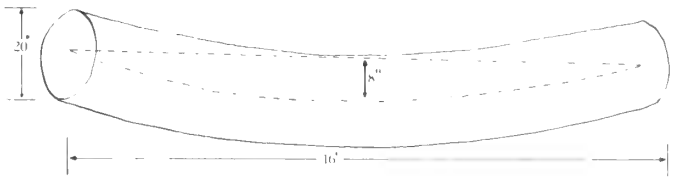
Defect section (rule 1):

Percent deduction $\frac{4}{16}$ 25%



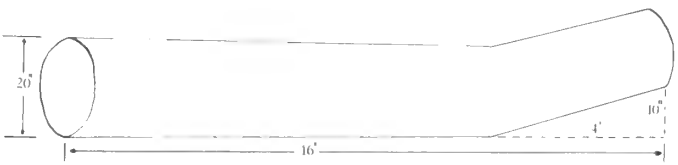
Defect section (rule 2)

Percent deduction $\left(\frac{6}{16}\right)\left(\frac{60}{360}\right)$ 6-1/4%



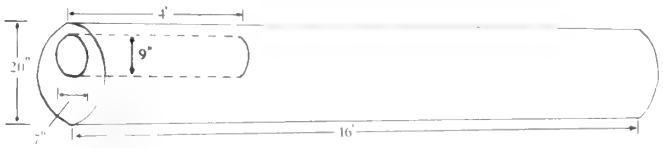
Sweep (rule 3)

Percent deduction $\frac{8}{20}\ \frac{2}{}$ 30%



Crook (rule 4)

Percent deduction $\left(\frac{10}{20}\right)\left(\frac{4}{16}\right)$ 12-1/2%



Interior defect (rule 5):

Percent deduction $\frac{(8)\ (10)}{(20\quad 1)^2} \times \frac{4}{16}$ 5-5/9%

In practice each elipse axis can be divided by (20 1) and rounded to nearest tenth if desired.

Thus $\frac{8}{19} = .4$, $\frac{10}{19}$ .5, and (.4) (.5) $\left(\frac{4}{16}\right)$ 5%

From: Grosenbaugh, L. R., SHORT CUTS FOR CRUISERS AND SCALERS. USDA Forest Serv. South. Forest Exp. Sta., Occas. Paper 126, 1952

Log grades are a classification of logs based on external characteristics as indicators of quality or value. The log-grade standards and grading systems for softwood and hardwood species used in this forest survey of New Hampshire are shown in the following specifications.

EASTERN WHITE PINE SAWLOG GRADE SPECIFICATIONS

GRADING FACTOR	LOG GRADE 1	LOG GRADE 2	LOG GRADE 3	LOG GRADE 4
(1) MINIMUM SCALING DIAMETER (inches)	14[1]	6	6	6
(2) MINIMUM LOG LENGTH (feet)	10[2]	8	8	8
(3) MAXIMUM WEEVIL INJURY (number)	None	None	2 injuries[3]	No limit
(4) MINIMUM FACE REQUIREMENTS	Two full length or four 50% length good faces.[4] (In addition, log knots on balance of faces shall not exceed size limitations of grade 2 logs.)	No GOOD FACES REQUIRED. Maximum diameter of log knots on three best faces: SOUND RED KNOTS not to exceed 1/6 scaling diameter and 3 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/12 scaling diameter and 1½ inch maximum.	SOUND RED KNOTS not to exceed 1/3 scaling diameter and 5 inch maximum. DEAD OR BLACK KNOTS including overgrown knots not to exceed 1/6 scaling diameter and 2½ inch maximum.	Includes all logs not qualifying for No. 3 or better and judged to have at least one-third of their gross volume in sound wood suitable for manufacture into standard lumber.
(5) MAXIMUM SWEEP OR CROOK ALLOWANCE (percent)	20	30	40	66⅔
(6) MAXIMUM TOTAL SCALING DEDUCTION (percent)	50	50	50	66⅔

After the tentative log grade is established from face examination, the log will be reduced in grade whenever the following defects are evident:

(7) CONKS, PUNK KNOTS, AND PINE BORER DAMAGE ON BARK SURFACE[5]

Degrade one grade if present on one face.
Degrade two grades if present on two faces.
Degrade three grades if present on three or more faces.

(8) LOG END DEFECTS: RED ROT, RING SHAKE, HEAVY STAIN AND PINE BORER DAMAGE OUTSIDE HEART CENTER OF LOG[5]

Consider log as having a total of 8 quarters (4 on each end) and degrade as indicated below:
Degrade one grade if present in 2 quarters of log ends.
Degrade two grades if present in 3 or 4 quarters of log ends.
Degrade three grades if present in 5 or more quarters of log ends.

[1]12 and 13 inch logs with four full length good faces are acceptable.
[2]8 foot logs with four full length good faces are acceptable.
[3]8 foot No. 3 logs limited to one weevil injury.
[4]Minimum 50% length good face must be at least 6 feet.
[5]Factors 7 and 8 are not cumulative (total degrade based on more serious of the two). No log to be degraded below grade 4 if net scale is at least one-third gross log scale.

From: Ostrander, M. D., and R. L. Brisbin, SAWLOG GRADES FOR EASTERN WHITE PINE. USDA For. Serv. Res. Pap. NE-205, 1971.

SPRUCE, FIR, HEMLOCK, TAMARACK, AND CEDAR LOG GRADE

(Minimum merchantability specifications)

Log grade	*Minimum size*		*Defect allowance*		*Other requirements*
	Diameter[1]	*Length*[2]	*Sweep or crook*	*Total deduction*	
	Inches	*Feet*	*Percent*	*Percent*	
1	10-12	8-16 in 2-foot multiples	25	50	Sound knots not over 2 inches in diameter permitted. Shake permitted up to 20 percent of gross scale if not combined with other serious defects.
	13+	8-16 in 2-foot multiples	25	50	Sound knots not over 3 inches in diameter permitted. Shake permitted up to 20 percent of gross scale if not combined with other serious defects.

[1] At small end of log.
[2] Without trim.

Forest Service standard grades for hardwood factory lumber logs.[a]

Grading Factors		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[b]	16-19	20+	11+[c]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear cuttings[d] of each of 3 best faces[e]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than ¼ of end in sound defects	15%			30%				50%
	For logs with more than ¼ of end in sound defects	10%			20%				35%
Maximum scaling deduction		40%[f]			50%[g]				50%

End defects, although not visible in standing trees, are important in grading cut logs. Instructions for dealing with this factor are contained in Forest Prod. Lab. Rpt. D 1737.

[a] From USDA Forest Service Research Paper FPL-63 (*13*).
[b] Ash and basswood butts can be 12 inches if they otherwise meet requirements for small #1's.
[c] Ten-inch logs of all species can be #2 if they otherwise meet requirements for small #1's.
[d] A clear cutting is a portion of a face, extending the width of the face, that is free of defects.
[e] A face is ¼ of the surface of the log as divided lengthwise.
[f] Otherwise #1 logs with 41-60% deductions can be # 2.
[g] Otherwise #2 logs with 51-60% deductions can be # 3.

Forest Service standard specifications for hardwood construction logs.[a]

Position in tree		Butt & upper
Min. diameter, small end		8 inches +
Min. length, without trim		8 feet
Clear cuttings		No requirements.
Sweep allowance, absolute		¼ diameter small end for each 8 feet of length.
Sound surface defects	Single knots	Any number, if no one knot has an average diameter above the callus in excess of ⅓ of log diameter at point of occurrence.
	Whorled knots	Any number if sum of knot diameters above the callus does not exceed ⅓ of log diameter at point of occurrence.
	Holes	Any number provided none has a diameter over ⅓ of log diameter at point of occurrence, and none extends over 3 inches into included timber.[b]
Unsound surface defects		Same requirements as for sound defects if they extend into included timber.[b] No limit if they do not.
End defects	Sound	No requirements.
	Unsound	None allowed; log must be sound internally, but will admit 1 shake not to exceed ¼ the scaling diameter and a longitudinal split not extending over 5 inches into the contained timber.

[a] These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only non-factory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, then it may be necessary to subdivide the class into grades.

[b] Included timber is always square, and dimension is judged from small end.

From: Rast, E. D., D. L. Sonderman, and G. L. Gammon, A GUIDE TO HARDWOOD LOG GRADING (REVISED). USDA For. Serv. Gen. Tech. Rep. NE-1, 1973.

Annual Net Growth and Timber Removals

Average annual net growth of growing stock.—The change (resulting from natural causes) in volume of sound wood in sawtimber and poletimber trees during the period between surveys, divided by the length of the period. (Components of annual net growth of growing stock include the increment in net volume of trees present at the beginning of the period and surviving to its end, plus net volume of trees reaching poletimber size during the period, minus the net volume of trees that died during the period, minus cull increment, the net volume of trees that became rough or rotten trees during the period.)

Average annual ingrowth of growing stock.—The net cubic-foot volume of trees now classed as growing stock that were less than 5.0 inches dbh on the initial survey, divided by the length of the period between surveys.

Average annual mortality of growing stock.—The net cubic-foot volume removed from the growing stock because of death from natural causes during the period between surveys, divided by the length of the period between surveys.

Average annual growing-stock removals.—The net cubic-foot volume of growing-stock trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys, converted to an annual basis.

Average annual net growth of sawtimber.—The change (resulting from natural causes) in net board-foot volume of sawtimber during the period between surveys, divided by the length of the period. (Components of annual net growth of sawtimber include the increment in net volume of sawtimber trees present at the beginning of the period and surviving to its end, plus the net volume of trees reaching sawtimber size during the period, minus the net volume of sawtimber trees that died during the period, minus the net volume of sawtimber trees that became rough or rotten trees during the period between surveys, cull increment.)

Average annual ingrowth of sawtimber.—The net board-foot volume of trees now classed as sawtimber that were not tallied as such on the initial survey, divided by the length of the period between surveys.

Average annual mortality of sawtimber.—The net board-foot volume removed from live sawtimber by death from natural causes during the period between surveys, divided by the length of the period between surveys.

Average annual sawtimber removals.—The net board-foot volume of sawtimber trees harvested or killed in logging, cultural operations such as timber-stand improvement, land-clearing, or changes in land use during the period between surveys, converted to an annual basis.

Cull increment.—The net volume of growing-stock trees on the initial inventory that became rough or rotten trees in the subsequent inventory.

Logging residues.—The unused growing-stock volume of trees cut for products and the total growing-stock volume of trees destroyed in the course of logging but not removed for products.

Other removals.—The growing-stock volume of trees that were removed from the inventory and not used for products, by cultural operations (weeding, thinning, etc.), land-clearing, and reclassification of some commercial forest land as noncommercial forest land.

Plant byproducts.—Wood products, such as slabs, edgings, and veneer cores, that are obtained incidental to the production of timber products and are utilized in the manufacture of other timber products. (Bark is not included.)

Plant residues.—Wood material produced incidental to the production of timber products but not utilized.

Roundwood products.—Logs, bolts, or other round sections cut from growing stock or nongrowing stock for industrial or nonindustrial uses.

Timber products.—Roundwood products and plant byproducts from all sources.

Timber removals.—The growing-stock volume of trees removed from the inventory for roundwood products, plus logging residues and other removals.

Annual net growth trend-level.—The estimated growth of growing stock or sawtimber for a specific year that is consistent with the average annual growth during the period between surveys and with the current inventory. (1972 for New Hampshire.)

II
FOREST SURVEY METHODS

The Northeastern Forest Experiment Station's Forest Survey project used the sampling with partial replacement (SPR) design in the reinventory of New Hampshire's timber resource. With this design, estimates of forest area and timber volume were made by combining a subsample of remeasured plots, a regression updating of the previous inventory, and a new independent photo- and ground-plot inventory. Thus the SPR design, by combining two independent estimates of the inventory, yields a statistically more accurate estimate of the timber resource than other methods at the same cost.

Remeasurement

One estimate is based on the updating of the 1960 survey. This required the remeasurement of 218 second-inventory ground plots. A total of 91 of these were among the 909 originally measured in 1948. The remaining 127 plots were installed as part of the 1960 inventory purposely to be remeasured. With the area-change and current-volume estimates obtained from the remeasurement sample plots, regression techniques were used to update all the 1960 inventory ground and photo plots to obtain an independent estimate of current timber volume and forest area.

In addition to estimating current timber volume and forest area, the forest survey of New Hampshire was designed to obtain an estimate of the components of average annual change during the period between the initial and the current inventories. The parameters of interest include area change from forest to nonforest and vice versa, timber growth, timber removals, and timber

mortality. All this information was obtained from the remeasured plots. The timber-change parameters were obtained by a tree-by-tree reconciliation of each remeasured plot. The reconciliation code for each remeasured tree was used to make estimates of the parameters of change, by species. The estimates of change were expressed as average annual figures by dividing the totals for the period by the number of years between measurements. These estimates were then used in the computations of annual net growth, mortality, and removals for 1972.

New-Ground Phase

The source of the new independent estimates of volume and forest area was a new aerial-photo stratification with a subsample of ground measurements. This photo sample of New Hampshire consisted of 15,756 points on the latest available aerial photography. A subset of 709 of these photo plots, including 114 on noforest land, was located on the ground. Land use was verified and the tree-measurement data were recorded for the 595 forested plots. Unlike the initial inventory, in which fixed-radius 1/5-acre plots were tallied, the new ground plots consisted of a cluster of 10 prism points systematically covering approximately 1 acre. At each point, trees were selected for tally by using a prism with a basal-area factor of 37.5. Area-attribute data were also tallied at each of the 10 points.

County Data

Many users of forest-survey data have shown a need for county information. To provide such information, within the framework of the survey design, tables for counties have been developed, based on a survey-unit partitioning technique.

First, the geographic stratum means and variances for the various photo-plot strata were applied to the photo-plot data for each county within the stratum. This yielded an estimate of total volume or total commercial forest-land area for each county. Next, the data from all the new ground plots in each geographic stratum were used to partition the county totals into their various components. For example, if a table of cubic-foot volume by softwoods and hardwoods is to be made for a county, the estimate of total cubic-foot volume for that county is partitioned into softwood and hardwood totals according to the proportion of softwoods and hardwoods for all new forest-survey ground plots within the geographic stratum.

Comparisons Between Inventories

After inventories have been completed for several points in time, it is desirable to evaluate the trends between the several inventories and to make comparisons. A comparison of the 1948, 1960, and 1973 forest-survey estimates of volume, growth, removals, and mortality was made for New Hampshire. A computer program, TRAS (Timber Resource Analysis System), was used.

Because of changes in procedures and in definitions, it was necessary to adjust the 1948 and 1960 inventory-volume estimates to what they would have been had the 1973 procedures and definitions been used in the 1948 and 1960 inventories. This process involved several calculations and adjustments of the 1948 and 1960 inventories in order to make them comparable with the 1973 inventory. An important step in this process was to recalculate the 1948 and 1960 inventory volume, using the average net volume per tree developed by the third inventory (1973). To do this, the average net volume per tree (for softwoods and hardwoods) developed from the third survey for each 2-inch diameter class was multiplied by the number of trees in each 2-inch diameter class from the 1948 and 1960 inventories. These calculations resulted in inventory estimates for 1948 and 1960 adjusted to 1973 standards and procedures. These adjusted estimates, not the estimates published in the reports of the earlier surveys, are the basis for comparisons between surveys shown in this report.

Data Processing

Field-tally data consisting of plot and individual-tree information were processed and compiled into various tables using FINSYS—Forest Inventory System—on modern large-capacity high-speed computers.

FINSYS is a data-processing system consisting primarily of a series of computer programs that was developed by the Northeastern Forest Experiment Station to process and compile a large volume of forest-inventory data. The system consists of an editing subsystem that edits field-tally data for errors; a table-compiling subsystem that compiles tables from edited field data; and finally, an output subsystem that expands the plot data to geographic-unit or statewide estimates and prints the final tables.

FINSYS was described in a series of research papers by R. W. Wilson and R. C. Peters in 1967: *The Northeastern Forest Inventory Data Processing System*, USDA Forest Service Research Papers NE-61 and NE-70 to 80.

Before modern computers came into use, the compiling of forest-inventory data was a major bottleneck in forest-inventory work. Using FINSYS, it is possible, as in the resurvey of New Hampshire, to have preliminary estimates available within 6 months after the last plot is taken. To process and compile data for a state the size of New Hampshire, from key-punching to the output of tables, requires about 2½ months of elapsed time and about 2½ hours of computer time.

FINSYS has several features that make it unique. One of these is the ability not only to calculate inventory estimates but also to calculate the variance and sampling error for each estimate. This feature provides the user with a measure of the reliability of each statistic and the ability to determine the reliability of a new estimate based upon any data combination he may make.

Another feature of FINSYS is its flexibility. The system is not restricted to the Northeastern forest survey but can be used for any large-scale forest inventory. Also, the system does not produce a standard set of tables. The individual user

specifies the tables to be developed according to his particular need. Thus at any stage in the data-processing phase or even at a later date, a specific table can be developed with minimum effort.

III
RELIABILITY OF THE ESTIMATES

The forest-area and timber-volume data presented in this report were based upon a carefully designed sample of forest conditions throughout New Hampshire. However, since neither every acre nor every tree in the State was measured, the data presented in this report are estimates. A measure of the reliability of these estimates is given by a sampling error. An associated sampling error was calculated for each estimate in this report. Many of these appear in the data tables.

Briefly, this is how the sampling error indicates the reliability of an estimate. The estimate of the total growing-stock volume in New Hampshire—6,579 million cubic feet—has an associated sampling error of 2 percent (132 million cubic feet). This means that the best estimate of the total growing-stock volume in New Hampshire in 1973 is 6,579 million cubic feet. If there are no errors in procedure, the odds are 2 to 1 that, if we repeated the survey in the same way, the resulting estimate of growing-stock volume would be between 6,447 million and 6,711 million cubic feet (6,579 ±132). Similarly, the odds are 19 to 1 that it would be within ±264 million cubic feet and 300 to 1 that it would be within ±396 million cubic feet.

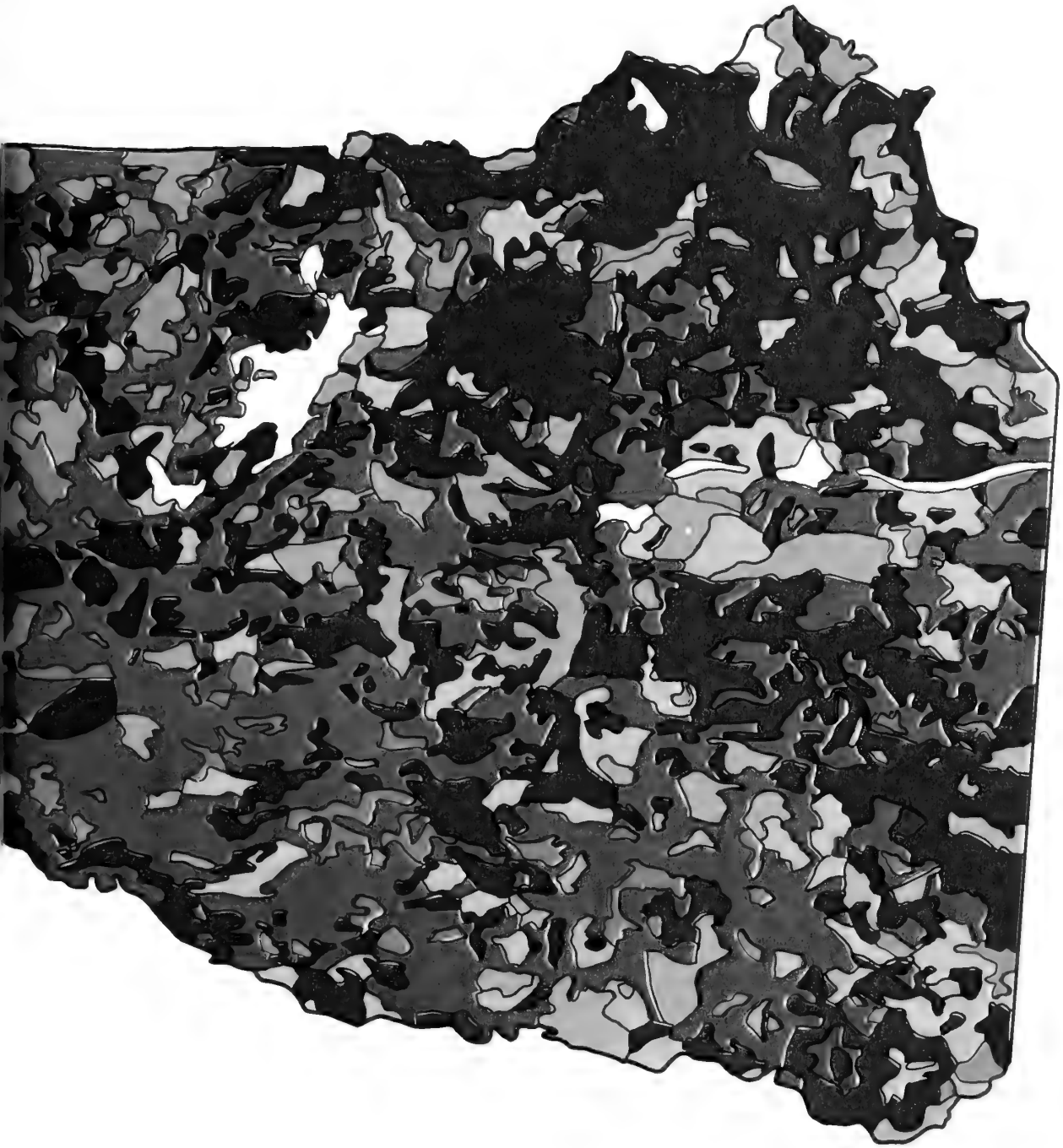
The computed sampling error is not a complete measure of reliability. There are other sources of error that this term does not include. There could be imperfections in volume tables and equations, and errors in field measurement. Procedural errors were kept to a minimum by careful training of all personnel, frequent inspection of field work, and application of the most reliable survey methods.

IV
COMMERCIAL TREE SPECIES OF NEW HAMPSHIRE

Occurrence[1]	*Common Name*	*Scientific Name*[2]
	Softwoods	
vc	Balsam fir	*Abies balsamea*
vr	Atlantic white-cedar	*Chamaecyparis thyoides*
c	Eastern redcedar (savin)[3]	*Juniperus virginiana*
r	Tamarack (larch, hackmatack)	*Larix laricina*
r	Norway spruce[4]	*Picea abies*
c	White spruce	*P. glauca*
r	Black spruce	*P. mariana*
vc	Red spruce	*P. rubens*
vr	Jack pine	*Pinus banksiana*
c	Red pine (Norway)	*P. resinosa*
r	Pitch pine	*P. rigida*
vc	Eastern white pine	*P. strobus*
r	Scotch pine[4]	*P. sylvestris*
vr	Douglas-fir[4]	*Psuedotsuga menziesii*
r	Northern white-cedar	*Thuja occidentalis*
vc	Eastern hemlock	*Tsuga canadensis*
	Hardwoods	
vc	Red maple	*Acer rubrum*
vr	Silver maple	*A. saccharinum*
vc	Sugar maple	*A. saccharum*
vc	Yellow birch	*Betula alleghaniensis*
c	Sweet birch (black)	*B. Lenta*
vc	Paper birch (white)	*B. papyrifera*
r	American hornbeam (blue beech)	*Carpinus caroliniana*
r	Hickory	*Carya species*
r	American chestnut	*Castanea dentata*
r	Flowering dogwood	*Cornus florida*
vc	American beech	*Fagus grandifolia*
c	White ash	*Fraxinus americana*

CONTINUED

THE MAJOR FOREST TYPES OF NEW HAMPSHIRE



Occurrence[1]	*Common Name*	*Scientific Name*[2]
vr	Black ash (brown)	*F. nigra*
vr	Green ash (red)	*F. pennsylvanica*
r	Butternut	*Juglans cinerea*
vr	Black tupelo (blackgum)	*Nyssa sylvatica*
c	Eastern hophornbeam (ironwood)	*Ostrya virginiana*
vr	American sycamore (buttonwood)	*Platanus occidentalis*
r	Balsam poplar (balm-of-Gilead)	*Populus balsamifera*
vr	Eastern cottonwood	*P. deltoides*
c	Bigtooth aspen (popple)	*P. grandidentata*
c	Quaking aspen (popple)	*P. tremuloides*
c	Black cherry	*Prunus serotina*
c	White oak	*Quercus alba*
vr	Swamp white oak	*Q. bicolor*
r	Scarlet oak	*Q. coccinea*
vr	Pin oak	*Q. palustris*
r	Chestnut oak	*Q. prinus*
vc	Northern red oak	*Q. rubra*
c	Black oak	*Q. velutina*
r	Black willow	*Salix nigra*
r	American basswood	*Tilia americana*
c	American elm (white)	*Ulmus americana*
r	Slippery elm	*U. rubra*

[1] Occurrence is based on the frequency at which the species was encountered on forest-survey field plots: vr = very rare, r = rare, c = common, and vc = very common.

[2] Names according to: Little, Elbert L., Jr. *Checklist of Native and Naturalized Trees of the United States (including Alaska).* U. S. Dep. Agric. Handb.. 41. 472 p., 1953.

[3] Names in parentheses are other frequently used common names.

[4] Species introduced in New Hampshire.

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Table 1.—Area by land classes, New Hampshire, 1973

Land class	Area	
	Thousand acres	*Percent*
Forest land:		
Commercial	4,692.0	81
Productive-reserved	48.7	1
Christmas-tree plantation	6.6	[a]
Unproductive	237.8	4
Total forest land	4,985.1	86
Nonforest:		
Cropland[b]	142.4	2
Pasture[b]	37.7	1
Other[c]	615.9	11
Total nonforest land	796.0	14
Total area[d]	5,781.1	100

[a] Less than 0.5 percent.

[b] Source: 1969 and 1964 Census of Agriculture. Total cropland includes cropland used for pasture. Pasture total based upon ratios developed from the 1964 census report. Data extrapolated to 1973.

[c] Includes swampland, industrial and urban areas, other nonforest land, and 46,694 acres classed as water by Forest Survey standards but defined by the Bureau of the Census as land.

[d] Source: United States Bureau of the Census. Areas of New Hampshire: 1960 (December 1966).

Table 2.—Area of commercial forest land, by ownership classes, New Hampshire, 1973

Ownership	Area[a]	
	Thousand acres	*Percent*
National Forest[b]	489.2	10
Other federal	12.6	[c]
State	79.2	2
County and municipal	28.9	1
Total public	609.9	13
Forest industry	946.9	20
Farmer owned:		
Individual	175.6	4
Corporate	8.0	[c]
Other	31.8	1
Total farmer owned	215.4	5
Miscellaneous private:		
Individual	2,283.2	49
Corporate	286.5	6
Other[d]	350.1	7
Total misc. private	2,919.8	62
All ownerships	4,692.0	100

[a] Estimates of area in each private ownership class are based upon forest-land ownership study by the Northeastern Forest Experiment Station.

[b] White Mountain National Forest, excluding 37,600 acres in Oxford County, Maine.

[c] Less than 0.5 percent.

[d] Includes acreage owned by business partnerships and organizations such as churches, Boy Scouts of America, and associations.

Table 3.—Area of commercial forest land, by stand-size and ownership classes, New Hampshire, 1973

[In thousands of acres]

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and other
Sawtimber stands	1,946.2	182.6	58.7	362.0	1,342.9
Poletimber stands	1,555.6	279.2	39.4	383.2	853.8
Sapling-seedling stands	1,155.0	27.4	22.6	201.7	903.3
Nonstocked areas	35.2	—	—	—	35.2
All classes	4,692.0	489.2	120.7	946.9	3,135.2

Table 4.—Area of commercial forest land, by stand-volume and ownership classes, New Hampshire, 1973

[In thousands of acres]

Stand-volume per acre (board feet)[a]	All ownerships	National Forest	Other public	Forest industry	Farmer and other
Less than 1,500	1,422.5	102.7	28.5	292.1	999.2
1,500 to 5,000	2,358.7	249.5	68.3	544.6	1,496.3
More than 5,000	910.8	137.0	23.9	110.2	639.7
All classes	4,692.0	489.2	120.7	946.9	3,135.2

[a] International ¼-inch rule.

Table 5.—Area of commercial forest land, by stocking classes based on selected stand components, New Hampshire, 1973

[In thousands of acres]

Stocking class[a] (percent)	Stocking classified in terms of—				
	All trees	Growing-stock trees			Rough and rotten trees
		Total	Desirable	Acceptable	
Overstocked:					
160	26.5	—	—	—	—
150 to 160	310.6	29.5	—	14.7	—
140 to 150	815.8	112.8	—	72.0	—
130 to 140	1,223.4	240.6	—	182.2	7.1
Total	2,376.3	382.9	—	268.9	7.1
Fully stocked:					
120 to 130	1,102.1	592.7	—	432.7	—
110 to 120	660.4	829.5	—	782.8	14.2
100 to 110	252.1	729.8	—	786.4	14.2
Total	2,014.6	2,152.0	—	2,001.9	28.4
Medium stocked:					
90 to 100	118.4	796.7	—	734.7	28.8
80 to 90	65.0	480.6	—	627.9	14.3
70 to 80	47.4	330.9	—	398.3	121.0
60 to 70	19.3	218.4	—	310.2	170.8
Total	250.1	1,826.6	—	2,071.1	334.9
Poorly stocked:					
50 to 60	11.5	96.0	4.9	86.5	218.7
40 to 50	13.6	88.6	7.2	112.8	479.6
30 to 40	12.0	57.0	58.8	57.0	728.4
20 to 30	13.9	53.7	161.0	58.6	1,117.3
10 to 20	—	7.1	531.2	7.1	1,062.3
Less than 10	—	28.1	3,928.9	28.1	715.3
Total	51.0	330.5	4,692.0	350.1	4,321.6
All classes	4,692.0	4,692.0	4,692.0	4,692.0	4,692.0

[a] Fully stocked stands are considered to contain 75 to 100 square feet of basal area per acre.

Table 6.—Area of commercial forest land, by area-condition and ownership classes, New Hampshire, 1973

[In thousands of acres]

Area-condition class[a]	All ownerships	National Forest	Other public	Forest industry	Farmer and other
Class *10-40*	—	—	—	—	—
Class *50*	2,260.7	117.4	57.1	452.2	1,634.0
Class *60*	2,067.9	313.1	52.8	403.0	1,299.0
Class *70*	363.4	58.7	10.8	91.7	202.2
All classes	4,692.0	489.2	120.7	946.9	3,135.2

[a] Class *10-40*.—Areas medium to fully stocked with desirable trees.
Class *50*.—Areas poorly stocked with desirable trees, but fully stocked with growing-stock trees.
Class *60*.—Areas poorly stocked with desirable trees, but with medium to full stocking of growing-stock trees..
Class *70*.—Areas poorly stocked with desirable trees, and poorly stocked with growing-stock trees.

Table 7.—Area of commercial forest land, by potential site productivity and ownership classes, New Hampshire, 1973

[In thousands of acres]

Growth-per-acre class (cubic feet)	All ownerships	National Forest	Other public	Forest industry	Farmer and other
120 to 165	450.5	7.3	11.1	120.6	311.5
85 to 120	1,175.9	99.3	12.2	361.2	703.2
50 to 85	1,742.5	152.2	39.5	302.8	1,248.0
Less than 50	1,323.1	230.4	57.9	162.3	872.5
All classes	4,692.0	489.2	120.7	946.9	3,135.2

Table 8.—Area of commercial forest land, by forest types and ownership classes, New Hampshire, 1973

[In thousands of acres]

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and other
White and red pine	1,344.6	—	39.4	41.2	1,264.0
Spruce/fir	635.9	93.8[a]	—	390.6	151.5
Pitch pine	35.8	—	—	—	35.8
Oak/pine	72.7	—	12.2	—	60.5
Oak/hickory	322.9	—	5.6	10.1	307.2
Elm/ash/red maple	737.6	—	11.6	60.4	665.6
Maple/beech/birch	1,308.3	360.2	40.6	414.3	493.2
Aspen/birch	234.2	35.2	11.3	30.3	157.4
All types	4,692.0	489.2	120.7	946.9	3,135.2

[a] The White Mountain National Forest recognizes a spruce-fir and a spruce-hardwood type in its management plan. The acreage of spruce-hardwood has been assigned to either spruce-fir or maple-beech-birch in this table, according to the portion of spruce to hardwood.

Table 9—Area of commercial forest land, by forest types and stand-size classes, New Hampshire, 1973

[In thousands of acres]

Forest type	All stands	Sawtimber stands	Poletimber stands	Sapling-seedlings stands	Nonstocked areas
White and red pine	1,344.6	836.8	237.1	256.4	14.3
Spruce/fir	635.9	169.7	253.8	212.4	—
Pitch pine	35.8	14.8	—	14.3	6.7
Oak/pine	72.7	37.0	7.2	28.5	—
Oak/hickory	322.9	107.5	158.1	57.3	—
Elm/ash/red maple	737.6	164.8	287.0	278.7	7.1
Maple/beech/birch	1,308.3	580.7	527.9	192.6	7.1
Aspen/birch	234.2	34.9	84.5	114.8	—
All types	4,692.0	1,946.2	1,555.6	1,155.0	35.2

Table 10.—Area of commercial forest land by local forest types and major forest types, New Hampshire, 1973

[In thousands of acres]

Local forest type and major forest type	Forest type	
	Local	Major
White and red pine:		
Red pine	14.3	—
White pine	809.5	—
White pine/hemlock	339.4	—
Hemlock	181.4	—
Total	—	1,344.6
Spruce/fir:		
Balsam fir	405.6	—
Red spruce/balsam fir	216.1	—
Northern white-cedar	7.6	—
White spruce	6.6	—
Total	—	635.9
Pitch pine:		
Eastern red cedar	6.7	—
Pitch pine	29.1	—
Total	—	35.8
Oak/pine:		
White pine/red oak/white ash	65.6	—
Other oak-pine	7.1	—
Total	—	72.7
Oak/hickory:		
Post, black, or bear oak	7.2	—
White oak, red oak, hickory	28.7	—
White oak	21.6	—
Northern red oak	251.1	—
Mixed hardwoods	14.3	—
Total	—	322.9
Elm/ash/red maple:		
Black ash/elm/red maple	730.5	—
Willow	7.1	—
Total	—	737.6
Maple/beech/birch:		
Sugar maple/beech/yellow birch	1,294.0	—
Black cherry	14.3	—
Total	—	1,308.3
Aspen/birch:		
Aspen	125.4	—
Paper birch	108.8	—
Total	—	234.2
All types	4,692.0	4,692.0.

Table 11.—Area of noncommercial forest land, by forest types, New Hampshire, 1973

[In thousands of acres]

Forest type	All areas	Productive-reserved areas	Unproductive areas
White and red pine	13.3	13.3	—
Spruce/fir	61.8	12.1	49.7
Pitch pine	.3	.3	—
Oak/pine	.6	.6	—
Oak/hickory	2.7	2.7	—
Elm/ash/red maple	59.3	7.7	51.6
Maple/beech/birch	112.1	14.1	98.0
Aspen/birch	43.0	4.5	38.5
All types	293.1	55.3	237.8

Table 12.—Number of trees on commercial forest land by species groups, tree classes, and diameter classes, New Hampshire, 1973

[In thousands of trees]

DBH class *(inches)*	Softwoods			Hardwoods		
	Growing-stock trees	Rough and rotten trees	Total	Growing-stock trees	Rough and rotten trees	Total
Saplings:						
1.0 to 2.9	420,930	209,677	630,607	674,122	665,016	1,339,138
3.0 to 4.9	257,722	48,398	306,120	348,674	204,689	553,363
Total	678,652	258,075	936,727	1,022,796	869,705	1,892,501
Poletimber:						
5.0 to 6.9	147,169	18,301	165,470	201,685	64,355	266,040
7.0 to 8.9	83,682	7,070	90,752	116,672	26,519	143,191
9.0 to 10.9	—	—	—	68,022	13,539	81,561
Total	230,851	25,371	256,222	386,379	104,413	490,792
Small sawtimber:						
9.0 to 10.9	50,857	4,633	55,490	—	—	—
11.0 to 12.9	25,392	3,122	28,514	34,261	8,592	42,853
13.0 to 14.9	14,056	1,520	15,576	16,110	4,423	20,533
Total	90,305	9,275	99,580	50,371	13,015	63,386
Large sawtimber:						
15.0 to 16.9	7,703	1,037	8,740	6,879	2,968	9,847
17.0 to 18.9	3,581	631	4,212	3,290	1,858	5,148
19.0 to 20.9	1,723	304	2,027	1,608	1,163	2,771
21.0 to 28.9	1,873	389	2,262	1,423	1,849	3,272
29.0 and larger	282	71	353	97	365	462
Total	15,162	2,432	17,594	13,297	8,203	21,500
All classes	1,014,970	295,153	1,310,123	1,472,843	995,336	2,468,179

Table 13.—Number of growing-stock trees on commercial forest land, by species and diameter classes, New Hampshire, 1973

[In thousands of trees]

Species	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[a]	116,925	42,408	25,236	18,606	12,166	7,924	4,984	2,552	1,287	1,549	213
Balsam fir	80,831	42,894	22,223	11,120	3,241	930	291	110	—	22	—
Spruce	73,441	38,089	20,354	9,336	3,038	1,382	796	302	109	32	3
Hemlock	61,699	22,810	14,831	11,213	6,434	3,549	1,594	617	327	258	66
Other softwoods	3,422	968	1,038	582	513	271	38	—	—	12	—
Total softwoods	336,318	147,169	83,682	50,857	25,392	14,056	7,703	3,581	1,723	1,873	282
Sugar maple	47,604	19,769	11,232	7,668	4,395	2,075	931	592	424	481	37
Red maple	127,574	61,850	35,293	17,477	7,701	3,238	1,268	359	185	198	5
Yellow birch	46,939	17,341	11,055	7,878	5,347	2,739	1,152	694	386	320	27
Paper birch	68,626	34,550	19,380	9,231	3,689	1,323	285	105	31	32	—
Beech	31,464	13,430	6,657	5,408	2,777	1,765	937	244	140	96	10
Ash	16,865	7,847	4,709	2,160	1,256	494	227	107	38	23	4
White oak	9,217	5,014	2,039	1,361	389	238	115	31	25	—	5
Northern red oak[b]	55,935	17,961	13,787	10,711	6,668	3,411	1,701	1,098	329	264	5
Black cherry	7,108	4,194	1,897	691	257	27	42	—	—	—	—
Aspen	22,358	11,139	5,951	3,556	1,154	447	111	—	—	—	—
Other hardwoods	16,357	8,590	4,672	1,881	628	353	110	60	50	9	4
Total hardwoods	450,047	201,685	116,672	68,022	34,261	16,110	6,879	3,290	1,608	1,423	97
All species	786,365	348,854	200,354	118,879	59,653	30,166	14,582	6,871	3,331	3,296	379

[a] Includes 5,767,000 red pine trees.
[b] Includes 4,359,000 black oak trees.

Table 14.—Net volume of timber on commercial forest land, by class of timber, softwoods and hardwoods, New Hampshire, 1973

[In millions of cubic feet]

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Sawlog portion	2,745.3	1,696.1	1,049.2
Upper-stem portion	495.0	225.2	269.8
All sawtimber trees	3,240.3	1,921.3	1,319.0
Poletimber trees	3,338.3	1,218.6	2,119.7
All growing-stock trees	6,578.6	3,139.9	3,438.7
Rough trees	537.0	212.6	324.4
Rotten trees	326.8	55.7	271.1
Total, all timber	7,442.4	3,408.2	4,034.2

Table 15.—Net volume of growing stock and sawtimber on commercial forest land, by ownership classes, stand-size classes, softwoods and hardwoods, New Hampshire, 1973

Ownership or stand-size class	Growing stock (million cubic feet)			Sawtimber (million board feet)[a]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
BY OWNERSHIP CLASSES						
National Forest[b]	869.5	262.3	607.2	1,833.8	547.4	1,286.4
Other public	169.5	52.3	117.2	329.0	140.1	188.9
Forest industry	1,287.5	712.3	575.2	2,136.3	1,167.2	969.1
Farmer and other	4,252.1	2,113.0	2,139.1	8,766.5	5,770.3	2,996.2
All ownership	6,578.6	3,139.9	3,438.7	13,065.6	7,625.0	5,440.6
BY STAND-SIZE CLASSES						
Sawtimber stands	3,553.7	1,929.2	1,624.5	9,230.0	5,587.2	3,642.8
Poletimber stands	2,323.7	854.9	1,468.8	2,832.7	1,373.0	1,459.7
Sapling-seedling stands	699.1	355.3	343.8	996.6	664.8	331.8
Nonstocked areas	2.1	.5	1.6	6.3	—	6.3
All classes	6,578.6	3,139.9	3,438.7	13,065.6	7,625.0	5,440.6

[a] International ¼-inch rule.

[b] In its management plan, the National Forest calculates cubic-foot volume on the basis of the number of 100-inch bolts in the tree. Forest Survey utilization standards which calculate cubic-foot volume in random lengths to 4-inch top give approximately 18 percent greater volume.

Table 16.—Net volume of growing stock and sawtimber on commercial forest land, by forest types, and softwoods and hardwoods, New Hampshire, 1973

Forest type	Growing stock (million cubic feet)			Sawtimber (million board feet)[a]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
White and red pine	2,151.9	1,579.2	573.7	5,095.0	4,451.4	643.6
Spruce/fir	957.4	777.5	179.9	1,459.3	1,224.5	234.8
Pitch pine	26.6	19.6	7.0	67.6	58.4	9.2
Oak/pine	101.5	26.6	74.9	227.2	79.0	148.2
Oak/hickory	469.8	79.6	390.2	795.3	187.9	607.4
Elm/ash/red maple	803.7	231.9	571.8	1,372.2	602.7	769.5
Maple/beech/birch	1,857.2	360.7	1,496.5	3,744.0	879.2	2,864.8
Aspen/birch	210.5	65.8	144.7	305.0	141.9	163.1
All types	6,578.6	3,139.9	3,438.7	13,065.6	7,625.0	5,440.6

[a] International ¼-inch rule.

Table 17.—Net volume of growing stock on commercial forest land, by species and diameter classes, New Hampshire, 1973

[In millions of cubic feet]

Species	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[a]	1,456.3	220.3	187.6	206.6	194.5	179.4	152.7	102.3	67.0	116.2	29.7
Balsam fir	541.3	161.2	153.0	126.5	58.7	25.1	10.1	5.4	—	1.3	—
Spruce	547.6	161.8	146.3	101.9	52.6	36.6	26.1	11.4	7.1	2.5	1.3
Hemlock	563.9	88.6	92.5	107.9	95.1	76.8	46.2	23.1	16.4	14.2	3.1
Other softwoods	30.8	2.1	5.2	5.8	8.6	7.2	1.2	—	—	.7	—
Total softwoods	3,139.9	634.0	584.6	548.7	409.5	325.1	236.3	142.2	90.5	134.9	34.1
Sugar maple	450.5	77.2	73.5	82.8	63.5	44.3	29.0	22.1	20.9	33.4	3.8
Red maple	854.8	213.8	216.4	177.0	111.7	65.7	36.2	12.5	8.3	12.8	4.
Yellow birch	416.5	57.2	62.3	79.5	65.2	49.9	34.9	24.6	17.7	22.7	2.5
Paper birch	399.9	115.3	110.6	89.4	45.7	23.8	8.3	3.6	1.3	1.9	—
Beech	271.1	46.2	41.6	58.6	36.1	35.6	28.3	9.3	7.7	6.7	1.0
Ash	132.2	29.3	30.3	24.3	19.0	11.4	7.1	4.8	2.0	2.6	1.4
White oak	53.1	17.4	10.4	11.3	4.5	3.9	2.7	1.1	1.1	—	.7
Northern red oak[b]	570.1	65.9	89.2	110.5	104.0	75.2	50.9	42.6	14.8	16.4	.6
Black cherry	37.0	14.8	11.0	6.3	3.4	.5	1.0	—	—	—	—
Aspen	153.2	41.8	40.3	39.6	18.0	10.0	3.5	—	—	—	—
Other hardwoods	100.3	31.5	27.5	16.9	8.6	6.9	2.9	2.3	2.2	.8	.7
Total hardwoods	3,438.7	710.4	713.1	696.2	479.7	327.2	204.8	122.9	76.0	97.3	11.1
All species	6,578.6	1,344.4	1,297.7	1,244.9	889.2	652.3	441.1	265.1	166.5	232.2	45.2

[a] Includes 49,100,000 cubic feet of red pine.
[b] Includes 39,900,000 cubic feet of black oak.

Table 18.—Net volume of sawtimber on commercial land, by species and diameter classes, New Hampshire, 1973

[In millions of board feet][a]

Species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[b]	4,286.6	683.9	753.8	751.5	668.1	465.5	305.3	525.1	133.4
Balsam fir	865.3	449.8	236.3	103.9	42.2	26.0	—	7.1	—
Spruce	922.0	360.8	206.6	149.4	113.0	45.3	30.8	9.4	6.7
Hemlock	1,462.1	359.5	367.3	316.2	192.3	99.0	66.5	55.5	5.8
Other softwoods	89.0	19.0	31.8	29.4	5.3	—	—	3.5	—
Total softwoods	7,625.0	1,873.0	1,595.8	1,350.4	1,020.9	635.8	402.6	600.6	145.9
Sugar maple	895.7	—	225.7	179.4	126.5	101.4	92.3	151.3	19.1
Red maple	977.7	—	406.1	264.1	153.1	55.4	38.4	58.7	1.9
Yellow birch	938.2	—	248.4	211.0	159.8	110.9	85.4	111.8	10.9
Paper birch	349.0	—	179.3	98.0	38.1	17.5	6.5	9.6	—
Beech	530.2	—	135.1	149.6	126.1	44.5	34.5	35.2	5.2
Ash	199.2	—	71.1	48.3	30.3	21.1	9.0	12.1	7.3
White oak	56.6	—	16.9	15.9	11.4	4.6	5.0	—	2.8
Northern red oak[c]	1,249.8	—	392.9	307.8	218.0	187.7	66.6	73.7	3.1
Black cherry	18.8	—	12.6	2.0	4.2	—	—	—	—
Aspen	124.0	—	67.3	41.3	15.4	—	—	—	—
Other hardwoods	101.4	—	32.7	29.2	12.1	10.0	10.2	3.8	3.4
Total hardwoods	5,440.6	—	1,788.1	1,346.6	895.0	553.1	347.9	456.2	53.7
All species	13,065.6	1,873.0	3,383.9	2,697.0	1,915.9	1,188.9	750.5	1,056.8	199.6

[a] International ¼-inch rule.
[b] Includes 90,700,000 board feet of red pine.
[c] Includes 79,500,000 board feet of black oak.

Table 19.—Net volume of sawtimber on commercial forest land, by species and quality classes, New Hampshire, 1973

[In millions of board feet][a]

Species	All classes	Standard-lumber logs			
		Grade 1	Grade 2	Grade 3	Grade 4[b]
Softwoods:					
White pine	4,195.9	49.0	419.0	2,160.5	1,567.4
Red pine	90.7	23.0	11.9	44.3	11.5
Other softwoods[c]	3,338.4	—	—	—	—
Total softwoods	7,625.0	72.0	430.9	2,204.8	1,578.9
Hardwoods:					
Sugar maple	895.7	148.1	164.1	467.4	116.1
Red maple	977.7	36.4	114.8	603.6	222.9
Yellow birch	938.2	141.0	242.4	494.5	60.3
Paper birch	349.0	27.3	71.5	199.4	50.8
Beech	530.2	19.9	56.3	337.7	116.3
Ash	199.2	26.2	50.8	79.0	43.2
White oak	56.6	1.6	13.2	28.6	13.2
Northern red oak	1,170.3	107.2	271.5	660.9	130.7
Black oak	79.5	.3	26.8	33.1	19.3
Black cherry	18.8	—	—	15.4	3.4
Aspen	124.0	1.3	10.5	72.1	40.1
Other hardwoods	101.4	9.8	9.8	65.3	16.5
Total hardwoods	5,440.6	519.1	1,031.7	3,057.0	832.8
			(In percent)		
Hardwood quality	100	10	19	56	15

[a] International ¼-inch rule.
[b] Grade 4 applies only to the pines. For hardwoods the volumes in this column are for construction logs.
[c] Species other than pine are not graded into standard-lumber grades.

Table 20.—Annual net growth, removals, and mortality of growing stock and sawtimber on commercial forest land, by species, New Hampshire, 1972

Species	Growing stock			Sawtimber		
	Annual net growth	Annual timber removals[a]	Annual mortality	Annual net growth	Annual timber removals[a]	Annual mortality
	Thousand cubic feet			*Thousand board feet*[b]		
Softwoods:						
White and red pine	70,505	18,006	2,888	217,084	69,535	8,037
Balsam fir	26,617	6,241	1,524	39,877	8,326	1,340
Spruce	7,232	3,054	1,727	24,475	5,883	1,807
Hemlock	20,835	4,780	914	50,404	20,190	968
Other softwoods	111	19	347	160	66	848
Total softwoods	125,300	32,100	7,400	332,000	104,000	13,000
Hardwoods:						
Sugar maple	13,482	3,479	360	30,396	2,889	(*)
Red maple	25,593	4,638	1,471	30,558	3,863	3,572
Yellow birch	4,872	6,277	1,272	9,781	12,142	1,826
Paper birch	16,170	4,545	1,502	15,228	3,553	1,960
Beech	7,371	1,366	828	27,680	9,324	526
Ash	3,592	624	118	8,630	2,724	605
White oak	793	196	98	1,407	8	28
Red oaks	25,876	7,355	45	65,603	23,281	(*)
Black cherry	1,699	480	(*)	977	355	(*)
Aspen	6,934	1,986	204	6,426	1,918	(*)
Other hardwoods	4,618	1,354	302	5,314	1,943	483
Total hardwoods	111,000	32,300	6,200	202,000	62,000	9,000
Total, all species	236,300	64,400	13,600	534,000	166,000	22,000

[a] Data for timber removals in this table are based on the trend from 1959 through 1972 and differ from those shown in table 27. Table 27 reports results of a canvass of timber removals for 1972.
[b] International ¼-inch rule.
(*) No mortality encountered at remeasured plot locations.

Table 21.—Annual net growth and removals of growing stock and sawtimber on commercial forest land, by ownership classes, softwoods and hardwoods, New Hampshire, 1972

Ownership	Annual net growth			Annual timber removals		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	GROWING STOCK *(thousand cubic feet)*					
National Forest	30,067	10,467	19,600	8,646	787	7,859
Other public	5,870	2,087	3,783	1,581	569	1,012
Forest industry	46,992	28,425	18,567	12,716	7,751	4,965
Farmer and other	153,371	84,321	69,050	41,457	22,993	18,464
All ownerships	236,300	125,300	111,000	64,400	32,100	32,300
	SAWTIMBER *(thousand board feet)*[a]					
National Forest	71,596	23,834	47,762	18,950	2,557	16,393
Other public	13,113	6,100	7,013	4,082	2,008	2,074
Forest industry	86,802	50,821	35,981	27,368	16,729	10,639
Farmer and other	362,489	251,245	111,244	115,600	82,706	32,894
All ownerships	534,000	332,000	202,000	166,000	104,000	62,000

[a] International ¼-inch rule.

Table 22.—Annual mortality of growing stock and sawtimber on commercial forest land, by ownership classes, causes, softwoods and hardwoods, New Hampshire, 1972

Ownership and cause	Growing stock (thousand cubic feet)			Sawtimber (thousand board feet)[a]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			BY OWNERSHIP CLASS			
National Forest	1,713	618	1,095	3,061	933	2,128
Other public	334	123	211	551	239	312
Forest industry	2,716	1,679	1,037	3,593	1,990	1,603
Farmer and other	8,837	4,980	3,857	14,795	9,838	4,957
All ownerships	13,600	7,400	6,200	22,000	13,000	9,000
			BY CAUSE			
Weather	2,327	1,412	915	6,540	4,656	1,884
Insects	53	53	(*)	(*)	(*)	(*)
Disease	8,758	4,857	3,901	13,051	7,579	5,472
Other	575	539	36	394	394	(*)
Unknown	1,887	539	1,348	2,015	371	1,644
All causes	13,600	7,400	6,200	22,000	13,000	9,000

[a] International ¼-inch rule.
(*) No mortality encountered at remeasured plot locations.

Table 23.—Components of annual net growth of growing stock and sawtimber on commercial forest land, softwoods and hardwoods, New Hampshire, 1972

Components	All species	Soft-woods	Hard-woods
	GROWING STOCK *Thousand cubic feet*		
Growth on initial growing-stock inventory[a]	111,581	62,946	48,635
Ingrowth—saplings that became poletimber	157,952	75,671	82,281
Gross growth	269,533	138,617	130,916
Cull increment	19,633	5,917	13,716
Annual mortality	13,600	7,400	6,200
Annual net growth	236,300	125,300	111,000
	SAWTIMBER *Thousand board feet*[b]		
Growth on initial sawtimber inventory[a]	256,317	185,335	70,982
Ingrowth—poletimber trees that became sawtimber	340,025	178,280	161,745
Gross growth	596,342	363,615	232,727
Cull increment	40,342	18,615	21,727
Annual mortality	22,000	13,000	9,000
Annual net growth	534,000	332,000	202,000

[a] Including growth on trees that were cut.
[b] International ¼-inch rule.

Table 24.—Sampling errors for major forest area and timber-volume classes in New Hampshire, 1973

Table No.	Item classification	Sampling error
	FOREST AREA	*Percent*
1	Forest-land area:	
	Commercial	0.8
	Unproductive	6.9
	Total	0.8
2	Ownership:	
	Forest industry	2
	Farmer owned	4
	Misc. private	1
	Farmer and misc. private	1
3	Stand-size class:	
	Sawtimber stands	5
	Poletimber stands	6
	Sapling-seedling stands	6
	Nonstocked areas	43
4	Stand-volume per acre (board feet):	
	Less than 1,500	6
	1,500 to 5,000	4
	More than 5,000	8
7	Area-condition class:	
	Class *50*	4
	Class *60*	5
	Class *70*	14
8	Growth-per-acre class (cubic feet):	
	120 to 165	12
	85 to 120	7
	50 to 85	5
	Less than 50	7
9	Forest type:	
	White and red pine	5
	Spruce/fir	9
	Pitch pine	45
	Oak/pine	31
	Oak/hickory	14
	Elm/ash/red maple	9
	Maple/beech/birch	7
	Aspen/birch	18
	TIMBER VOLUME	
		Cubic feet / *Board feet*
		Percent
14	Class of timber:	
	Sawtimber trees	3 / —
	Poletimber trees	2 / —
	All growing stock	2 / —
	Rough trees	5 / —
	Rotten trees	5 / —
	All live trees	2 / —
15	Ownership:	
	National Forest	4 / 7
	Other public	22 / 24
	Forest industry	10 / 12
	Farmer and other	3 / 3
15	Stand-size class:	
	Sawtimber stands	4 / 4
	Poletimber stands	7 / 8
	Sapling-seedling	9 / 12
	Nonstocked areas	* / *
16	Forest type:	
	White and red pine	6 / 6
	Spruce/fir	10 / 13
	Pitch pine	* / *
	Oak/pine	34 / 39
	Oak/hickory	15 / 18
	Elm/ash/red maple	10 / 12
	Maple/beech/birch	8 / 9
	Aspen/birch	25 / 32
17-18	Diameter classes (inches):	
	5.0- 6.9	3 / —
	7.0- 8.9	3 / —
	9.0-10.9[a]	3 / 5
	11.0 12.9	4 / 4
	13.0-14.9	4 / 4
	15.0-16.9	6 / 5
	17.0-18.9	7 / 6
	19.0-20.9	8 / 8
	21.0-28.9	9 / 9
	29.0 and larger	16 / 15
17-18	Species	
	White and red pine	6 / 6
	Balsam fir	9 / 11
	Spruce	8 / 9
	Hemlock	8 / 9
	Other softwoods	31 / 34
	All softwoods	3 / 4
	Sugar maple	8 / 10
	Red maple	5 / 9
	Yellow birch	7 / 9
	Paper birch	8 / 12
	Beech	10 / 13
	Ash	12 / 16
	White oak	20 / 35
	Red oaks	8 / 10
	Black cherry	17 / 35
	Aspen	13 / 23
	Other hardwoods	12 / 18
	All hardwoods	3 / 4
	All species	2 / 3
	GROWTH REMOVAL	
21	Growth by:	
	Softwoods	10 / 11
	Hardwoods	8 / 12
	All species	6 / 8
21	Removals by:	
	Softwoods	23 / 23
	Hardwoods	30 / 25
	All species	18 / 20
	MORTALITY	
22	By species group:	
	Softwoods	16 / 24
	Hardwoods	16 / 39
	All species	13 / 20
22	By cause:	
	Weather	32 / 40
	Insects	* / —
	Disease	14 / 24
	Other	35 / *
	Unknown	26 / *

* Sampling errors of 50 to 99 percent.
[a] Board-foot sampling error for this class is for softwoods only.

Table 25.—Output of timber products, by source of material, softwoods and hardwoods, New Hampshire, 1972

Product and species group	Standard units	Total output		Output from roundwood		Output from plant byproducts	
		Number of units	Thousand cubic feet	Number of units	Thousand cubic feet	Number of units	Thousand cubic feet
Sawlogs:							
Softwood	M bd. ft.[a]	133,463	22,649	133,463	22,649	—	—
Hardwood	M bd. ft.[a]	48,519	7,817	48,519	7,817	—	—
Total	M bd. ft.[a]	181,982	30,466	181,982	30,466	—	—
Veneer logs and bolts:							
Softwood	M bd. ft.[a]	—	—	—	—	—	—
Hardwood	M bd. ft.[a]	2,067	333	2,067	333	—	—
Total	M bd. ft.[a]	2,067	333	2,067	333	—	—
Pulpwood:							
Softwood	Std. cords[b]	137,973	11,718	63,873	5,429	74,100	6,289
Hardwood	Std. cords[b]	173,435	14,742	136,835	11,631	36,600	3,111
Total	Std. cords[b]	311,408	26,460	200,708	17,060	110,700	9,400
Cooperage logs and bolts:							
Softwood	M bd. ft.[a]	1,972	335	1,972	335	—	—
Hardwood	M bd. ft.[a]	—	—	—	—	—	—
Total	M bd. ft.[a]	1,972	335	1,972	335	—	—
Piling:							
Softwood	M linear ft.	6	3	6	3	—	—
Hardwood	M linear ft.	—	—	—	—	—	—
Total	M linear ft.	6	3	6	3	—	—
Posts (round and split):							
Softwood	M pieces	10	9	10	9	—	—
Hardwood	M pieces	10	8	10	8	—	—
Total	M pieces	20	17	20	17	—	—
Other:[c]							
Softwood	M cu. ft.	188	188	86	86	102	102
Hardwood	M cu. ft.	1,911	1,911	1,905	1,905	6	6
Total	M cu. ft.	2,099	2,099	1,991	1,991	108	108
Total industrial products:							
Softwood	M cu. ft.	—	34,902	—	28,511	—	6,391
Hardwood	M cu. ft.	—	24,811	—	21,694	—	3,117
Total	M cu. ft.	—	59,713	—	50,205	—	9,508
Fuelwood:							
Softwood	Std. cords	5,562	445	—	—	5,562	445
Hardwood	Std. cords	24,031	1,922	18,668	1,493	5,363	429
Total	Std. cords	29,593	2,367	18,668	1,493	10,925	874
All products:[d]							
Softwood	M cu. ft.	—	35,347	—	28,511	—	6,836
Hardwood	M cu. ft.	—	26,733	—	23,187	—	3,546
Total	M cu. ft.	—	62,080	—	51,698	—	10,382[e]

[a] International ¼-inch rule.
[b] Rough wood basis, includes chips converted to equivalent standard cords.
[c] Includes dimension, excelsior, and turnery bolts.
[d] Does not include 3,212,000 cubic feet of softwood and 990,000 cubic feet of hardwood residues used for agricultural bedding.
[e] Pulpwood from plant residues does not agree with table 6 in Resource Bulletin NE-35, *Primary Wood-Products Industries of New Hampshire and Vermont, 1972*, because of different data sources.

Table 26.—Output of roundwood products, by source, softwoods and hardwoods, New Hampshire, 1972

[In thousands of cubic feet]

Product and species group	All sources	Growing-stock trees[a]			Rough and rotten trees[a]	Salvable dead trees[a]	Other sources[b]
		Total	Sawtimber	Poletimber			
PRINCIPAL INDUSTRIAL PRODUCTS							
Sawlogs:							
Softwood	22,649	19,879	19,635	244	222	176	2,372
Hardwood	7,817	7,206	6,956	250	99	31	481
Total	30,466	27,085	26,591	494	321	207	2,853
Veneer logs and bolts:							
Softwood	—	—	—	—	—	—	—
Hardwood	333	312	301	11	—	—	21
Total	333	312	301	11	—	—	21
Pulpwood:							
Softwood	5,429	5,091	3,767	1,324	—	36	302
Hardwood	11,631	8,822	7,439	1,383	1,469	517	823
Total	17,060	13,913	11,206	2,707	1,469	553	1,125
MISCELLANEOUS INDUSTRIAL PRODUCTS							
Cooperage logs and bolts:							
Softwood	335	299	295	4	—	—	36
Hardwood	—	—	—	—	—	—	—
Total	335	299	295	4	—	—	36
Piling:							
Softwood	3	3	3	—	—	—	—
Hardwood	—	—	—	—	—	—	—
Total	3	3	3	—	—	—	—
Posts (round and split):							
Softwood	9	8	6	2	—	—	1
Hardwood	8	6	3	3	1	—	1
Total	17	14	9	5	1	—	2
Other:							
Softwood	86	79	53	26	4	—	3
Hardwood	1,905	1,463	791	672	141	—	301
Total	1,991	1,542	844	698	145	—	304
Total industrial products:							
Softwood	28,511	25,359	23,759	1,600	226	212	2,714
Hardwood	21,694	17,809	15,490	2,319	1,710	548	1,627
Total	50,205	43,168	39,249	3,919	1,936	760	4,341
NONINDUSTRIAL PRODUCTS							
Fuelwood:							
Softwood	—	—	—	—	—	—	—
Hardwood	1,493	961	493	468	95	94	343
Total	1,493	961	493	468	95	94	343
Total, all products:							
Softwood	28,511	25,359	23,759	1,600	226	212	2,714
Hardwood	23,187	18,770	15,983	2,787	1,805	642	1,970
Total	51,698	44,129	39,742	4,387	2,031	854	4,684

[a] On commercial forest land.

[b] Includes trees less than 5.0 inches in diameter, tree tops and limbs from commercial forest areas, or any material from noncommercial forest land or nonforest land such as fence rows and suburban areas.

Table 27.—Timber removals from growing stock and sawtimber on commercial forest land, by items, softwoods and hardwoods, New Hampshire, 1972

Item	Growing stock			Sawtimber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	Thousand cubic feet			*Thousand board feet*[a]		
Roundwood products:						
Sawlogs	27,085	19,879	7,206	131,797	95,548	36,249
Veneer logs and bolts	312	—	312	1,428	—	1,428
Pulpwood	13,913	5,091	8,822	50,329	17,262	33,067
Cooperage logs and bolts	299	299	—	1,151	1,151	—
Piling	3	3	—	15	15	—
Posts	14	8	6	38	24	14
Other	1,542	79	1,463	3,834	213	3,621
Fuelwood	961	—	961	2,256	—	2,256
All products	44,129	25,359	18,770	190,848	114,213	76,635
Logging residues	10,039	4,537	5,502	17,000	6,287	10,713
Other removals	10,780	5,262	5,518	22,260	12,773	9,487
Total removals	64,948	35,158	29,790	230,108	133,273	96,835

[a] International ¼-inch rule.

Table 28.—Volume of unused residues at primary manufacturing plants, by industry and type of residue, and softwoods and hardwoods, New Hampshire, 1972

[In thousands of cubic feet]

Species group and type of residues	All industries	Lumber	Veneer and plywood	Other
Softwoods:				
Coarse[a]	656	631	—	25
Fine[b]	602	588	—	14
Total	1,258	1,219	—	39
Hardwoods:				
Coarse[a]	74	65	—	9
Fine[b]	146	142	—	4
Total	220	207	—	13
All species:				
Coarse[a]	730	696	—	34
Fine[b]	748	730	—	18
Total	1,478	1,426	—	52

[a] Material such as slabs, edgings, and veneer cores.
[b] Material such as sawdust and shavings.

Table 29.—Projections of net annual growth, timber removals, and inventory of growing stock and sawtimber on commercial forest land in New Hampshire, 1973-2003[a]

Species group	1973 (inventory year)	1983	1993	2003
	GROWING STOCK *(thousand cubic feet)*			
Softwoods:				
Removals	32.1	37	43	52
Growth	125.3	130	126	122
Inventory	3,139.9	3,568	3,842	4,153
Hardwoods:				
Removals	32.2	37	44	53
Growth	111.0	115	112	108
Inventory	3,438.7	3,907	4,208	4,547
Total:				
Removals	64.4	74	87	105
Growth	236.3	245	238	230
Inventory	6,578.6	7,475	8,050	8,700
	SAWTIMBER *(thousand board feet)*			
Softwoods:				
Removals	104.0	119	139	168
Growth	332.0	344	344	323
Inventory	7,625.0	8,663	9,329	10,084
Hardwoods:				
Removals	62.0	71	85	83
Growth	202.0	209	204	197
Inventory	5,440.6	6,182	6,658	7,194
Total:				
Removals	166.0	190	224	251
Growth	534.0	553	538	520
Inventory	13,065.6	14,845	15,987	17,278

[a] Based upon the following assumptions: The area of commercial forest will decrease at a constant rate of 0.35 percent per year. Net annual growth as a percentage of inventory will increase and then decline as optimum stocking is reached and then exceeded. Timber removals will reflect expected timber-product demands and land-use changes.

Table 30.—Projections of net annual growth, timber removals, and inventory of growing stock and sawtimber on commercial forest land in New Hampshire, 1973-2003[a]

Species group	1973 (inventory year)	1983	1993	2003
	GROWING STOCK *(thousand cubic feet)*			
Softwoods:				
Removals	32.1	58	90	119
Growth	125.3	137	138	120
Inventory	3,139.9	3,819	4,290	4,447
Hardwoods:				
Removals	32.2	58	90	120
Growth	111.0	121	122	119
Inventory	3,438.7	4,183	4,698	4,870
Total:				
Removals	64.4	116	180	239
Growth	236.3	258	260	239
Inventory	6,578.6	8,002	8,988	9,317
	SAWTIMBER *(thousand board feet)*			
Softwoods:				
Removals	104.0	188	292	386
Growth	332.0	363	366	318
Inventory	7,625.0	9,273	10,417	10,798
Hardwoods:				
Removals	62.0	112	173	231
Growth	202.0	220	222	217
Inventory	5,440.6	6,618	7,433	7,705
Total:				
Removals	166.0	300	465	617
Growth	534.0	583	588	535
Inventory	13,065.6	15,891	17,850	18,503

[a] Based upon the following assumptions: The area of commercial forest will decrease at a constant rate of 0.35 percent per year. Total growing stock growth and removals will be in balance at 2.6 percent of the inventory at the end of 30 years.

Table 31.—Area by land classes, geographic units, and counties, New Hampshire, 1973

Unit and county	Total land area[a]	Nonforest land use	Forest-land area			
			Non-commercial[b]	Commercial		Sampling error[c]
	Thousand acres				*Percent*	
Carroll	600.2	50.8	34.6	514.8	86	2
Coos	1,164.7	57.1	101.0	1,006.6	86	1
Grafton	1,108.3	114.9	103.0	890.4	80	2
Northern Unit	2,873.2	222.8	238.6	2,411.8	84	0.6
Belknap	256.1	50.2	2.3	203.6	80	5
Cheshire	457.8	66.9	8.0	382.9	84	3
Hillsborough	571.6	115.5	14.6	411.5	77	4
Merrimack	595.3	110.1	6.9	478.3	80	3
Rockingham	442.0	111.4	14.8	315.8	71	4
Strafford	240.3	56.1	2.7	181.5	76	5
Sullivan	344.8	63.0	5.2	276.6	80	5
Southern Unit	2,907.9	573.2	54.5	2,280.2	78	1.4
Total	5,781.1	796.0	293.1	4,692.0	81	0.8

[a] Source: Areas of New Hampshire: 1960 (December 1966), Bureau of the Census.
[b] Includes nonproductive and productive-reserved forest land.
[c] In percent for commercial forest land, at the 68-percent probability level.

Table 32.—Area of commercial forest land, by ownership classes, geographic units, and counties, New Hampshire, 1973

[In thousands of acres]

Unit and county	Public-owned[a]			Private-owned		Total
	National Forest[b]	State	County and municipal	Farmer-owned	Other private	
Carroll	124.4	8.8	3.1	12.1	366.4	514.8
Coos	127.9	10.0	1.9	40.1	826.7	1,006.6
Grafton	236.9	13.3	3.3	61.1	575.8	890.4
Northern Unit	489.2	32.1	8.3	113.3	1,768.9	2,411.8
Belknap	.9	2.3	2.1	9.4	188.9	203.6
Cheshire	1.2	13.0	2.2	12.1	354.4	382.9
Hillsborough	1.9	4.4	5.2	18.7	411.3	441.5
Merrimack	8.6	14.9	4.6	21.5	428.7	478.3
Rockingham	—	6.3	2.2	14.4	292.9	315.8
Strafford	—	1.4	1.1	11.6	167.4	181.5
Sullivan	—	4.8	3.2	14.4	254.2	276.6
Southern Unit	12.6	47.1	20.6	102.1	2,097.8	2,280.2
Total	501.8	79.2	28.9	215.4	3,866.7	4,692.0

[a] From ownership records.
[b] Includes 12,600 acres of other federal in the Southern unit.

Table 33.—Area of commercial forest land, by stand-size classes, geographic units, and counties, New Hampshire, 1973

[In thousands of acres]

Unit and county	Sawtimber stands	Poletimber stands	Sapling-seedling stands	Nonstocked areas	Total
Carroll	192.7	183.9	133.0	5.2	514.8
Coos	409.9	351.5	237.6	7.6	1,006.6
Grafton	342.9	336.4	202.6	8.5	890.4
Northern Unit	945.5	871.8	573.2	21.3	2,411.8
Belknap	90.4	62.1	50.0	1.1	203.6
Cheshire	167.8	122.7	91.1	1.3	382.9
Hillsborough	200.5	131.4	106.5	3.1	441.5
Merrimack	194.0	149.0	132.6	2.7	478.3
Rockingham	149.9	86.3	77.5	2.1	315.8
Strafford	81.2	49.0	50.0	1.3	181.5
Sullivan	116.9	83.3	74.1	2.3	276.6
Southern Unit	1,000.7	683.8	581.8	13.9	2,280.2
Total	1,946.2	1,555.6	1,155.0	35.2	4,692.0

Table 34.—Area of commercial forest land, by stand-volume classes and geographic units, New Hampshire, 1973

Stand-volume per acre (board feet)[a]	Northern unit		Southern unit		State total	
	Thousand acres	Percent	Thousand acres	Percent	Thousand acres	Percent
Less than 1,500	783.4	32	639.1	28	1,422.5	30
1,500 to 5,000	1,177.8	49	1,180.9	52	2,358.7	50
More than 5,000	450.6	19	460.2	20	910.8	20
All classes	2,411.8	100	2,280.2	100	4,692.0	100

[a] International ¼-inch rule.

Table 35.—Area of commercial forest land, by potential site productivity and geographic units, New Hampshire, 1973

[In thousands of acres]

Growth-per-acre class (cubic feet)	Northern unit	Southern unit	Total
120 to 165	305.9	144.6	450.5
85 to 120	668.1	507.8	1,175.9
50 to 85	794.3	948.2	1,742.5
Less than 50	643.5	679.6	1,323.1
All classes	2,411.8	2,280.2	4,692.0

Table 36.—Area of commercial forest land, by forest types, geographic units, and counties, New Hampshire, 1973

[In thousands of acres]

Unit and county	Forest type								Total
	White and red pine	Spruce/ fir	Pitch pine	Oak/ pine	Oak/ hickory	Elm/ ash/red maple	Maple/ beech/ birch	Aspen/ birch	
Carroll	82.0	122.8	2.0	5.7	18.2	46.7	207.1	30.3	514.8
Coos	163.9	279.2	3.1	13.6	36.0	85.5	370.9	54.4	1,006.6
Grafton	124.6	197.1	2.0	9.4	31.3	80.1	390.2	55.7	890.4
Northern Unit	370.5	599.1	7.1	28.7	85.5	212.3	968.2	140.4	2,411.8
Belknap	90.8	3.7	2.6	3.1	20.7	44.7	30.1	7.9	203.6
Cheshire	156.6	5.7	4.1	5.9	44.4	90.2	61.8	14.2	382.9
Hillsborough	185.8	7.0	5.2	9.8	47.5	99.2	69.2	17.8	441.5
Merrimack	193.5	6.9	5.9	11.2	49.5	118.8	71.3	21.2	478.3
Rockingham	147.1	5.7	4.0	5.3	29.6	67.7	43.0	13.4	315.8
Strafford	79.3	3.1	2.2	3.4	18.5	41.2	25.3	8.5	181.5
Sullivan	121.0	4.7	4.7	5.3	27.2	63.5	39.4	10.8	276.6
Southern Unit	974.1	36.8	28.7	44.0	237.4	525.3	340.1	93.8	2,280.2
Total	1,344.6	635.9	35.8	72.7	322.9	737.6	1,308.3	234.2	4,692.0

Table 37.—Net volume of timber on commercial forest land, by class of timber and geographic units, New Hampshire, 1973

[In millions of cubic feet]

Class of timber	Northern unit	Southern unit	Total
Sawtimber trees:			
Sawlog portion	1,379.0	1,366.3	2,745.3
Upper-stem portion	265.0	230.0	495.0
All sawtimber trees	1,644.0	1,596.3	3,240.3
Poletimber trees	1,787.0	1,551.3	3,338.3
All growing-stock trees	3,431.0	3,147.6	6,578.6
Rough trees	232.2	304.8	537.0
Rotten trees	214.3	112.5	326.8
Total, all timber	3,877.5	3,564.9	7,442.4

Table 38.—Net volume of growing stock on commercial forest land, by tree classes, geographic units, and counties, New Hampshire, 1973

[In millions of cubic feet]

Unit and county	Sawtimber trees	Pole-timber trees	Total growing stock
Carroll	344.7	369.3	714.0
Coos	687.1	766.6	1,453.7
Grafton	612.2	651.1	1,263.3
Northern Unit	1,644.0	1,787.0	3,431.0
Belknap	146.2	140.3	286.5
Cheshire	265.3	268.0	533.3
Hillsborough	315.2	305.1	620.3
Merrimack	316.4	318.9	635.3
Rockingham	237.8	216.8	454.6
Strafford	128.2	119.8	248.0
Sullivan	187.2	182.4	369.6
Southern Unit	1,596.3	1,551.3	3,147.6
Total	3,240.3	3,338.3	6,578.6

Table 39.—Net volume of growing stock and sawtimber on commercial forest land, by ownership classes, softwoods and hardwoods, and geographic units, New Hampshire, 1973

Ownership class	Growing stock (million cubic feet)			Sawtimber (million board feet)[a]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			NORTHERN UNIT			
National Forest	869.5	262.3	607.2	1,833.8	547.4	1,286.4
Other public	62.6	21.4	41.2	134.7	60.3	74.4
Forest industry	1,199.5	684.3	515.2	2,021.8	1,098.7	923.1
Farmer and other	1,299.4	604.3	695.1	2,624.2	1,535.7	1,088.5
All ownerships	3,431.0	1,572.3	1,858.7	6,614.5	3,242.1	3,372.4
			SOUTHERN UNIT			
National Forest	—	—	—	—	—	—
Other public	106.9	30.9	76.0	194.3	79.8	114.5
Forest industry	88.0	28.0	60.0	114.5	68.5	46.0
Farmer and other	2,952.7	1,508.7	1,444.0	6,142.3	4,234.6	1,907.7
All ownerships	3,147.6	1,567.6	1,580.0	6,451.1	4,382.9	2,068.2

[a] International ¼-inch rule.

Table 40.—Net volume of growing stock and sawtimber on commercial forest land, by stand-size classes, softwoods and hardwoods, and geographic units, New Hampshire, 1973

Stand-size class	Growing stock (million cubic feet)			Sawtimber (million board feet)[a]		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
			NORTHERN UNIT			
Sawtimber stands	1,739.9	821.3	918.6	4,536.7	2,148.1	2,388.6
Poletimber stands	1,365.7	565.1	800.6	1,663.8	825.3	838.5
Other stands	325.4	185.9	139.5	414.0	268.7	145.3
All stands	3,431.0	1,572.3	1,858.7	6,614.5	3,242.1	3,372.4
			SOUTHERN UNIT			
Sawtimber stands	1,813.8	1,107.9	705.9	4,693.3	3,439.1	1,254.2
Poletimber stands	958.0	289.8	668.2	1,168.9	547.7	621.2
Other stands	375.8	169.9	205.9	588.9	396.1	192.8
All stands	3,147.6	1,567.6	1,580.0	6,451.1	4,382.9	2,068.2

[a] International ¼-inch rule.

Table 41.—Net volume of growing stock on commerccial forest land, by stand-size classes, geographic units, and counties, New Hampshire, 1973

Unit and county	Sawtimber stands	Poletimber stands	Other stands	Total	Sampling error of total
		Million cubic feet			*Percent*
Carroll	355.9	284.5	73.6	714.0	7
Coos	752.2	559.8	141.7	1,453.7	4
Grafton	631.8	521.4	110.1	1,263.3	5
Northern Unit	1,739.9	1,365.7	325.4	3,431.0	2.2
Belknap	165.5	87.5	33.5	286.5	8
Cheshire	298.9	172.9	61.5	533.3	7
Hillsborough	367.2	185.2	67.9	620.3	6
Merrimack	343.4	205.9	86.0	635.3	6
Rockingham	284.1	121.2	49.3	454.6	8
Strafford	149.6	69.1	29.3	248.0	10
Sullivan	205.1	116.2	48.3	369.6	8
Southern Unit	1,813.8	958.0	375.8	3,147.6	2.5
Total	3,553.7	2,323.7	701.2	6,578.6	1.7

Table 42.—Net volume of sawtimber on commercial forest land, by stand-size classes, geographic units, and counties, New Hampshire, 1973

Unit and county	Sawtimber stands	Poletimber stands	Other stands	Total	Sampling error of total
		Million board feet[a]			*Percent*
Carroll	940.4	353.4	93.5	1,387.3	11
Coos	1,916.1	661.9	180.6	2,758.6	7
Grafton	1,680.2	648.5	139.9	2,468.6	8
Northern Unit	4,536.7	1,663.8	414.0	6,614.5	3.7
Belknap	431.6	107.2	52.6	591.4	13
Cheshire	764.0	210.5	97.6	1,072.1	10
Hillsborough	943.8	224.3	104.6	1,272.7	9
Merrimack	891.9	252.7	134.5	1,279.1	9
Rockingham	737.7	148.0	75.6	961.3	11
Strafford	388.1	83.5	46.1	517.7	14
Sullivan	536.2	142.7	77.9	756.8	12
Southern Unit	4,693.3	1,168.9	588.9	6,451.1	3.7
Total	9,230.0	2,832.7	1,002.9	13,065.6	2.6

[a] International ¼-inch rule.

Table 43.—Net volume of growing stock on commercial forest land, by forest types, geographic units, and counties, New Hampshire, 1973

[In millions of cubic feet]

Unit and county	Forest type								Total
	White and red pine	Spruce/ fir	Pitch pine	Oak/ pine	Oak/ hickory	Elm/ ash/red maple	Maple/ beech/ birch	Aspen/ birch	
Carroll	120.5	172.3	—	9.4	30.2	46.1	307.1	28.4	714.0
Coos	254.0	431.5	—	26.1	59.3	90.1	527.8	64.9	1,453.7
Grafton	181.7	290.7	—	17.0	50.3	80.7	587.3	55.6	1,263.3
Northern Unit	556.2	894.5	—	52.5	139.8	216.9	1,422.2	148.9	3,431.0
Belknap	150.1	6.5	2.6	3.6	29.3	50.3	38.5	5.6	286.5
Cheshire	254.7	9.5	4.1	6.8	63.6	105.5	79.3	9.8	533.3
Hillsborough	312.1	12.6	4.7	11.0	65.7	114.2	88.4	11.6	620.3
Merrimack	304.7	11.1	5.3	11.9	69.3	128.0	91.6	13.4	635.3
Rockingham	254.8	10.3	4.3	5.8	40.3	75.1	54.8	9.2	454.6
Strafford	131.5	5.6	2.1	3.6	23.8	44.9	31.6	4.9	248.0
Sullivan	187.8	7.3	3.5	6.3	38.0	68.8	50.8	7.1	369.6
Southern Unit	1,595.7	62.9	26.6	49.0	330.0	586.8	435.0	61.6	3,147.6
Total	2,151.9	957.4	26.6	101.5	469.8	803.7	1,857.2	210.5	6,578.6

Table 44.—Net volume of sawtimber on commercial forest land, by forest types, geographic units, and counties, New Hampshire, 1973

[In millions of board feet][a]

Unit and county	Forest type								Total
	White and red pine	Spruce/ fir	Pitch pine	Oak/ pine	Oak/ hickory	Elm/ ash/red maple	Maple/ beech/ birch	Aspen/ birch	
Carroll	270.5	266.8	—	29.0	60.4	76.0	640.8	43.8	1,387.3
Coos	586.9	641.5	—	71.6	114.2	149.6	1,109.5	85.3	2,758.6
Grafton	401.8	468.3	—	50.0	98.3	132.1	1,228.9	89.2	2,468.6
Northern Unit	1,259.2	1,376.6	—	150.6	272.9	357.7	2,979.2	218.3	6,614.5
Belknap	364.7	8.4	6.5	4.9	46.8	84.5	67.4	8.2	591.4
Cheshire	606.6	12.7	10.6	9.6	100.1	179.4	139.3	13.8	1,072.1
Hillsborough	750.6	16.2	11.8	20.6	102.9	195.5	158.5	16.6	1,272.7
Merrimack	722.1	15.2	13.6	17.0	110.0	224.1	159.9	17.2	1,279.1
Rockingham	627.4	13.2	10.8	8.4	63.7	129.5	94.1	14.2	961.3
Strafford	319.7	7.1	5.4	5.8	37.5	80.5	54.6	7.1	517.7
Sullivan	444.7	9.9	8.9	10.3	61.4	121.0	91.0	9.6	756.8
Southern Unit	3,835.8	82.7	67.6	76.6	522.4	1,014.5	764.8	86.7	6,451.1
Total	5,095.0	1,459.3	67.6	227.2	795.3	1,372.2	3,744.0	305.0	13,065.6

[a] International ¼-inch rule.

Table 45.—Net volume of growing stock on commercial forest land in Northern geographic unit, by species, and counties, New Hampshire, 1973

[In millions of cubic feet]

Species	Counties			Northern unit
	Carroll	Coos	Grafton	
White and red pine	78.8	156.4	118.4	353.6
Balsam fir	100.2	262.0	170.2	532.4
Spruce	89.1	194.2	158.9	442.2
Hemlock	47.9	101.6	85.2	234.7
Other softwoods	2.1	4.3	3.0	9.4
Total softwoods	318.1	718.5	535.7	1,572.3
Sugar maple	64.4	140.7	128.5	333.6
Red maple	74.0	132.9	131.0	337.9
Yellow birch	80.7	134.6	150.4	365.7
Paper birch	58.0	99.1	102.5	259.6
Beech	44.1	68.9	82.0	195.0
Ash	12.6	27.0	24.8	64.4
White oak	.5	1.2	1.1	2.8
Northern red oak	34.2	71.6	60.7	166.5
Black cherry	3.4	7.4	6.1	16.9
Aspen	20.4	45.3	34.9	100.6
Other hardwoods	3.6	6.5	5.6	15.7
Total hardwoods	395.9	735.2	727.6	1,858.7
All species	714.0	1,453.7	1,263.3	3,431.0

Table 46.—Net volume of growing stock on commercial forest land in Southern geographic unit, by species and counties, New Hampshire, 1973

[In millions of cubic feet]

Species	Counties							Southern unit
	Belknap	Cheshire	Hillsborough	Merrimack	Rockingham	Strafford	Sullivan	
White and red pine	101.5	173.1	218.4	211.1	177.1	92.7	128.8	1,102.7
Balsam fir	.8	1.5	1.5	2.0	1.2	.7	1.2	8.9
Spruce	10.3	16.3	21.3	19.1	17.1	9.3	12.0	105.4
Hemlock	30.9	56.5	63.5	65.4	48.4	25.6	38.9	329.2
Other softwoods	2.0	3.4	3.7	4.4	3.2	1.8	2.9	21.4
Total softwoods	145.5	250.8	308.4	302.0	247.0	130.1	183.8	1,567.6
Sugar maple	10.1	20.7	24.2	24.4	14.7	8.7	14.1	116.9
Red maple	45.9	91.3	101.4	109.2	69.3	39.2	60.6	516.9
Yellow birch	4.2	9.5	10.8	10.4	6.3	3.8	5.8	50.8
Paper birch	12.9	24.4	27.1	29.6	19.4	10.6	16.3	140.3
Beech	7.2	13.6	14.8	16.0	10.1	5.5	8.9	76.1
Ash	5.7	12.3	13.6	14.4	8.6	5.3	7.9	67.8
White oak	4.1	8.9	10.3	10.8	6.6	3.9	5.7	50.3
Northern red oak	36.9	74.1	79.1	85.2	51.6	28.9	47.8	403.6
Black cherry	1.6	3.6	4.0	4.3	2.7	1.6	2.3	20.1
Aspen	4.8	8.8	10.0	11.5	7.1	4.0	6.4	52.6
Other hardwoods	7.6	15.3	16.6	17.5	11.2	6.4	10.0	84.6
Total hardwoods	141.0	282.5	311.9	333.3	207.6	117.9	185.8	1,580.0
All species	286.5	533.3	620.3	635.3	454.6	248.0	369.6	3,147.6

Table 47.—Net volume of sawtimber on commercial forest land in Northern geographic unit, by species and counties, New Hampshire, 1973

[In millions of board feet][a]

Species	Counties			Northern unit
	Carroll	Coos	Grafton	
White and red pine	224.9	457.2	339.2	1,021.3
Balsam fir	159.8	420.3	281.8	861.9
Spruce	157.4	305.3	285.9	748.6
Hemlock	118.6	261.2	209.5	589.3
Other softwoods	4.8	9.2	7.0	21.0
Total softwoods	665.5	1,453.2	1,123.4	3,242.1
Sugar maple	136.8	287.3	270.4	694.5
Red maple	103.9	184.5	185.1	473.5
Yellow birch	196.4	321.7	369.1	887.2
Paper birch	55.5	93.4	99.7	248.6
Beech	96.8	145.6	182.1	424.5
Ash	23.2	52.9	47.8	123.9
Northern red oak	82.0	166.2	142.7	390.9
Black cherry	1.5	3.0	2.5	7.0
Aspen	16.5	34.0	30.7	81.2
Other hardwoods	9.2	16.8	15.1	41.1
Total hardwoods	721.8	1,305.4	1,345.2	3,372.4
All species	1,387.3	2,758.6	2,468.6	6,614.5

[a] International ¼-inch rule.

Table 48.—Net volume of sawtimber on commercial forest land in Southern geographic unit, by species and counties, New Hampshire, 1973

[In millions of cubic feet][a]

Species	Counties							Southern unit
	Belknap	Cheshire	Hillsborough	Merrimack	Rockingham	Strafford	Sullivan	
White and red pine	304.1	511.5	642.9	623.9	529.5	274.9	378.5	3,265.3
Balsam fir	.4	.6	.6	.7	.4	.2	.5	3.4
Spruce	16.5	28.2	33.8	33.0	27.2	14.5	20.2	173.4
Hemlock	81.8	150.7	167.8	174.4	127.9	67.4	102.8	872.8
Other softwoods	6.2	10.8	12.0	13.7	10.2	5.9	9.2	68.0
Total softwoods	409.0	701.8	857.1	845.7	695.2	362.9	511.2	4,382.9
Sugar maple	16.5	34.7	44.2	40.5	25.4	15.9	24.0	201.2
Red maple	43.4	87.0	100.2	107.6	66.7	39.1	60.2	504.2
Yellow birch	3.9	8.8	11.3	10.7	5.9	4.0	6.4	51.0
Paper birch	9.2	17.7	19.6	20.9	14.0	7.5	11.5	100.4
Beech	9.9	19.2	20.5	22.8	13.5	7.4	12.4	105.7
Ash	6.0	13.4	15.7	16.0	9.3	6.0	8.9	75.3
White oak	4.8	10.4	11.1	12.6	7.1	4.2	6.4	56.6
Northern red oak	78.2	158.4	171.2	177.3	109.5	62.3	102.0	858.9
Black cherry	.9	2.2	2.5	2.3	1.5	1.2	1.2	11.8
Aspen	4.3	7.9	8.0	9.2	5.5	2.7	5.2	42.8
Other hardwoods	5.3	10.6	11.3	13.5	7.7	4.5	7.4	60.3
Total hardwoods	182.4	370.3	415.6	433.4	266.1	154.8	245.6	2,068.2
All species	591.4	1,072.1	1,272.7	1,279.1	961.3	517.7	756.8	6,451.1

[a] International ¼-inch rule.

Table 49.—Net volume of growing stock on commercial forest land in Northern geographic unit, by species and diameter classes, New Hampshire, 1973

[In millions of cubic feet]

Species	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[a]	353.6	61.6	43.3	44.0	40.1	33.3	32.4	22.4	22.3	39.5	14.7
Balsam fir	532.4	155.0	151.4	125.4	58.7	25.1	10.1	5.4	—	1.3	—
Spruce	442.2	133.6	114.4	82.0	41.5	30.9	18.8	11.4	7.1	2.5	—
Hemlock	234.7	36.3	36.4	42.1	34.7	30.5	20.1	10.8	9.8	10.9	3.1
Other softwoods	9.4	1.5	2.2	2.8	2.0	.4	.5	—	—	—	—
Total softwoods	1,572.3	388.0	347.7	296.3	177.0	120.2	81.9	50.0	39.2	54.2	17.8
Sugar maple	333.6	52.4	50.5	62.5	46.9	32.9	23.9	18.2	16.5	27.0	2.8
Red maple	337.9	70.7	78.5	68.3	48.8	33.6	16.7	6.2	4.9	10.2	—
Yellow birch	365.7	46.8	51.1	63.2	58.1	48.0	33.9	23.6	16.3	22.2	2.5
Paper birch	259.6	75.6	71.3	53.5	28.6	17.9	6.8	3.2	.8	1.9	—
Beech	195.0	30.1	26.0	40.3	27.2	27.6	21.6	8.8	6.6	5.8	1.0
Ash	64.4	10.0	12.9	12.0	10.1	5.7	5.2	3.3	2.0	1.8	1.4
White oak	2.8	1.3	.5	1.0	—	—	—	—	—	—	—
Northern red oak[b]	166.5	17.5	26.6	28.0	29.5	23.8	17.2	14.6	3.7	5.0	.6
Black cherry	16.9	5.5	5.1	4.4	1.4	—	.5	—	—	—	—
Aspen	100.6	24.5	26.7	28.3	14.4	5.7	1.0	—	—	—	—
Other hardwoods	15.7	2.2	3.0	1.0	1.2	4.7	.6	.7	.8	.8	.7
Total hardwoods	1,858.7	336.6	352.2	362.5	266.2	199.9	127.4	78.6	51.6	74.7	9.0
All species	3,431.0	724.6	699.9	658.8	443.2	320.1	209.3	128.6	90.8	128.9	26.8

[a] Includes 13,000,000 cubic feet of red pine.
[b] Includes 7,400,000 cubic feet of black oak.

Table 50.—Net volume of growing stock on commercial forest land in Southern geographic unit, by species and diameter classes, New Hampshire, 1973

[In millions of cubic feet]

Species	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[a]	1,102.7	158.7	144.3	162.6	154.4	146.1	120.3	79.9	44.7	76.7	15.0
Balsam fir	8.9	6.2	1.6	1.1	—	—	—	—	—	—	—
Spruce	105.4	28.2	31.9	19.9	11.1	5.7	7.3	—	—	—	1.3
Hemlock	329.2	52.3	56.1	65.8	60.4	46.3	26.1	12.3	6.6	3.3	—
Other softwoods	21.4	.6	3.0	3.0	6.6	6.8	.7	—	—	.7	—
Total softwoods	1,567.6	246.0	236.9	252.4	232.5	204.9	154.4	92.2	51.3	80.7	16.3
Sugar maple	116.9	24.8	23.0	20.3	16.6	11.4	5.1	3.9	4.4	6.4	1.0
Red maple	516.9	143.1	137.9	108.7	62.9	32.1	19.5	6.3	3.4	2.6	.4
Yellow birch	50.8	10.4	11.2	16.3	7.1	1.9	1.0	1.0	1.4	.5	—
Paper birch	140.3	39.7	39.3	35.9	17.1	5.9	1.5	.4	.5	—	—
Beech	76.1	16.1	15.6	18.3	8.9	8.0	6.7	.5	1.1	.9	—
Ash	67.8	19.3	17.4	12.3	8.9	5.7	1.9	1.5	—	.8	—
White oak	50.3	16.1	9.9	10.3	4.5	3.9	2.7	1.1	1.1	—	.7
Northern red oak[b]	403.6	48.4	62.6	82.5	74.5	51.4	33.7	28.0	11.1	11.4	—
Black cherry	20.1	9.3	5.9	1.9	2.0	.5	.5	—	—	—	—
Aspen	52.6	17.3	13.6	11.3	3.6	4.3	2.5	—	—	—	—
Other hardwoods	84.6	29.3	24.5	15.9	7.4	2.2	2.3	1.6	1.4	—	—
Total hardwoods	1,580.0	373.8	360.9	333.7	213.5	127.3	77.4	44.3	24.4	22.6	2.1
All species	3,147.6	619.8	597.8	586.1	446.0	332.2	231.8	136.5	75.7	103.3	18.4

[a] Includes 36,100,000 cubic feet of red pine.
[b] Includes 32,500,000 cubic feet of black oak.

Table 51.—Net volume of sawtimber on commercial forest land in Northern geographic unit, by species and diameter classes, New Hampshire, 1973

[In millions of board feet][a]

Species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[b]	1,021.3	148.8	154.5	133.0	138.4	97.9	100.9	181.2	66.6
Balsam fir	861.9	446.4	236.3	103.9	42.2	26.0	—	7.1	—
Spruce	748.6	296.0	162.7	124.6	79.8	45.3	30.8	9.4	—
Hemlock	589.3	142.5	129.9	118.0	75.5	41.7	35.8	40.1	5.8
Other softwoods	21.0	9.4	7.5	2.0	2.1	—	—	—	—
Total softwoods	3,242.1	1,043.1	690.9	481.5	338.0	210.9	167.5	237.8	72.4
Sugar maple	694.5	—	162.3	132.7	104.9	84.1	72.4	123.1	15.0
Red maple	473.5	—	168.2	135.2	71.8	27.7	23.1	47.5	—
Yellow birch	887.2	—	221.7	203.4	155.3	106.8	79.1	110.0	10.9
Paper birch	248.6	—	113.9	73.8	31.7	15.5	4.1	9.6	—
Beech	424.5	—	100.9	117.0	97.8	42.4	30.1	31.1	5.2
Ash	123.9	—	37.1	25.0	22.2	14.8	9.0	8.5	7.3
Northern red oak[c]	390.9	—	108.7	97.0	74.7	66.8	17.0	23.6	3.1
Black cherry	7.0	—	4.9	—	2.1	—	—	—	—
Aspen	81.2	—	53.4	23.1	4.7	—	—	—	—
Other hardwoods	41.1	—	4.5	19.8	2.6	3.2	3.8	3.8	3.4
Total hardwoods	3,372.4	—	975.6	827.0	567.8	361.3	238.6	357.2	44.9
All species	6,614.5	1,043.1	1,666.5	1,308.5	905.8	572.2	406.1	595.0	117.3

[a] International ¼-inch rule.
[b] Includes 36,300,000 board feet of red pine.
[c] Includes 20,200,000 board feet of black oak.

Table 52.—Net volume of sawtimber on commercial forest land in Southern geographic unit, by species and diameter classes, New Hampshire, 1973

[In millions of board feet][a]

Species	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
White and red pine[b]	3,265.3	535.1	599.3	618.5	529.7	367.6	204.4	343.9	66.8
Balsam fir	3.4	3.4	—	—	—	—	—	—	—
Spruce	173.4	64.8	43.9	24.8	33.2	—	—	—	6.7
Hemlock	872.8	217.0	237.4	198.2	116.8	57.3	30.7	15.4	—
Other softwoods	68.0	9.6	24.3	27.4	3.2	—	—	3.5	—
Total softwoods	4,382.9	829.9	904.9	868.9	682.9	424.9	235.1	362.8	73.5
Sugar maple	201.2	—	63.4	46.7	21.6	17.3	19.9	28.2	4.1
Red maple	504.2	—	237.9	128.9	81.3	27.7	15.3	11.2	1.9
Yellow birch	51.0	—	26.7	7.6	4.5	4.1	6.3	1.8	—
Paper birch	100.4	—	65.4	24.2	6.4	2.0	2.4	—	—
Beech	105.7	—	34.2	32.6	28.3	2.1	4.4	4.1	—
Ash	75.3	—	34.0	23.3	8.1	6.3	—	3.6	—
White oak	56.6	—	16.9	15.9	11.4	4.6	5.0	—	2.8
Northern red oak[c]	858.9	—	284.2	210.8	143.3	120.9	49.6	50.1	—
Black cherry	11.8	—	7.7	2.0	2.1	—	—	—	—
Aspen	42.8	—	13.9	18.2	10.7	—	—	—	—
Other hardwoods	60.3	—	28.2	9.4	9.5	6.8	6.4	—	—
Total hardwoods	2,068.2	—	812.5	519.6	327.2	191.8	109.3	99.0	8.8
All species	6,451.1	829.9	1,717.4	1,388.5	1,010.1	616.7	344.4	461.8	82.3

[a] International ¼-inch rule.
[b] Includes 54,400,000 board feet of red pine.
[c] Includes 59,400,000 board feet of black oak.

Table 53.—Net volume of sawtimber on commercial forest land in Northern geographic unit, by species and quality classes, New Hampshire, 1973

[In millions of board feet][b]

Species	All classes	Standard-lumber logs			
		Grade 1	Grade 2	Grade 3	Grade 4[b]
Softwoods:					
White pine	985.0	30.6	131.4	492.1	330.9
Red pine	36.3	5.4	2.6	21.8	6.5
Other softwoods[c]	2,220.8	—	—	—	—
Total softwoods	3,242.1	36.0	134.0	513.9	337.4
Hardwoods:					
Sugar maple	694.5	144.2	141.1	327.7	81.5
Red maple	473.5	31.9	81.5	246.0	114.1
Yellow birch	887.2	140.2	236.0	455.9	55.1
Paper birch	248.6	25.6	67.6	123.4	32.0
Beech	424.5	19.1	52.2	253.2	100.0
Ash	123.9	26.2	35.6	39.7	22.4
Northern red oak	370.8	65.4	86.1	182.4	36.9
Black oak	20.1	.1	5.6	8.0	6.4
Black cherry	7.0	—	—	5.7	1.3
Aspen	81.2	1.3	6.6	43.0	30.3
Other hardwoods	41.1	5.6	3.1	25.3	7.1
Total hardwoods	3,372.4	459.6	715.4	1,710.3	487.1
			(In percent)		
Hardwood quality	100	14	21	51	14

[a] International ¼-inch rule.

[b] Grade 4 applies only to the pines. For hardwoods the volumes in this column are for construction logs.

[c] Species other than pine are not graded into standard-lumber grades.

Table 54.—Net volume of sawtimber on commercial forest land in Southern geographic unit, by species and quality classes, New Hampshire, 1973

[In millions of board feet][b]

Species	All classes	Standard-lumber logs			
		Grade 1	Grade 2	Grade 3	Grade 4[b]
Softwoods:					
White pine	3,210.9	18.4	287.6	1,668.4	1,236.5
Red pine	54.4	17.6	9.3	22.5	5.0
Other softwoods[c]	1,117.6	—	—	—	—
Total softwoods	4,382.9	36.0	296.9	1,690.9	1,241.5
Hardwoods:					
Sugar maple	201.2	3.9	23.0	139.7	34.6
Red maple	504.2	4.5	33.3	357.6	108.8
Yellow birch	51.0	.8	6.4	38.6	5.2
Paper birch	100.4	1.7	3.9	76.0	18.8
Beech	105.7	.8	4.1	84.5	16.3
Ash	75.3	—	15.2	39.3	20.8
White oak	56.6	1.6	13.2	28.6	13.2
Northern red oak	799.5	41.8	185.4	478.5	93.8
Black oak	59.4	.2	21.2	25.1	12.9
Black cherry	11.8	—	—	9.7	2.1
Aspen	42.8	—	3.9	29.1	9.8
Other hardwoods	60.3	4.2	6.7	40.0	9.4
Total hardwoods	2,068.2	59.5	316.3	1,346.7	345.7
		(In percent)			
Hardwood quality	100	3	15	65	17

[a] International ¼-inch rule.
[b] Grade 4 applies only to the pines. For hardwoods the volumes in this column are for construction logs.
[c] Species other than pine are not graded into standard-lumber grades.

Headquarters of the Northeastern Forest Experiment Station are in Upper Darby, Pa. Field laboratories and research units are maintained at:

- Amherst, Massachusetts, in cooperation with the University of Massachusetts.
- Beltsville, Maryland.
- Berea, Kentucky, in cooperation with Berea College.
- Burlington, Vermont, in cooperation with the University of Vermont.
- Delaware, Ohio.
- Durham, New Hampshire, in cooperation with the University of New Hampshire.
- Hamden, Connecticut, in cooperation with Yale University.
- Kingston, Pennsylvania.
- Morgantown, West Virginia, in cooperation with West Virginia University, Morgantown.
- Orono, Maine, in cooperation with the University of Maine, Orono.
- Parsons, West Virginia.
- Pennington, New Jersey.
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- Syracuse, New York, in cooperation with the State University of New York College of Environmental Sciences and Forestry at Syracuse University, Syracuse.
- Warren, Pennsylvania.

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1976. **The forest resources of New Hampshire.** Northeast For. Exp. Stn., Upper Darby, Pa.
71 p., illus. (USDA For. Serv. Resour. Bull. NE-43)

A statistical and analytical report on the third forest survey of New Hampshire. Statistical findings are based on the remeasurement of ⅕-acre plots and new 10-point cluster plots. Trends in forest-land area, timber volume, annual growth, and timber removals are discussed; also timber-products output by forest industries, based upon a canvass of industries in 1973, and the importance of timber and forests to the State's economy and environment. The report includes a discussion of the outlook for timber supplies during the next 30 years, and forest management opportunities in the State. The report includes 54 tables of statistical data.

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